MODERN PLASTICS

E. F. LOUGEE, Editor • DR. G. M. KLINE, Technical Editor • C. A. BRESKIN, Publisher

JUNE 1940

VOLUME 17 NUMBER 10

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Cover color this month CRUISE ROSE (Created by Textile Color Card Association)

Member of Controlled CCA Circulation Audit

Published the 5th of each month by Breskin Publishing Corporation, 122 E. 42nd St. (Chanin Bldg.), New York, N. Y. Phone Ashland 4-0655. Western office, 221 N. LaSalle St., Room 1338, Chicago, Ill. Phone Randolph 6336. Publication office Twentieth and Northampton Sts., Easton, Pa. Also Publishers of Modern Packaging, Packaging Catalog.

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Subscription price $5.00 per year in United States, its possessions and Canada. All other countries, $6.00 per year. Price this issue, 50¢ per copy.

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Printed in U. S. A. Acceptance under the Act of June 5, 1934, at Easton, Pa., authorized Nov. 24, 1936. Back numbers dated 3 months or more preceding current issue, when available, $1.00 per copy, excepting October issues which are $2.00.

PHOTO, COURTESY CELLULOID CORP.

JULY

Plastics have come a long way since the days of the Celluloid collar—until now they may be found in almost every industry. The automotive and aircraft industries today consume a large percentage of new synthetic products and for this reason the Society of Automotive and Aircraft Engineers recently invited Dr. Gordon M. Kline, our Technical Editor, to discuss the important applications. In approaching this subject, Dr. Kline prepared a comprehensive chronological survey of the development of plastics in this country. This has turned out to be the best history and analysis of plastics written to date.

The complete report outlines the special properties which characterize each material, traces its growth and applications and describes the important uses which have been made of the various synthetics in the automobile and airplane. We shall present this history in three parts—the first installment will head the July Technical Section.

Mr. Riche writes a letter

New York City
Chicago
Boston

Cable Address
Micorp

MICRO SWITCH CORPORATION
FREEPORT, ILLINOIS, U. S. A.

March 21, 1940

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Lockland (Cincinnati), Ohio
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Advertising Manager

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MODERN PLASTICS

JUNE 1940 VOLUME 17 NUMBER 10

Just relax!

by J. G. VAJDA

Manicurists and clients alike, share the comfort and convenience offered by this new molded device

NOT long ago the Paulgene Appliance Corp. devised the Pro-Care manicuring unit which we picture here. The idea is not only unique, but quite revolutionary—nothing like it has ever appeared before.

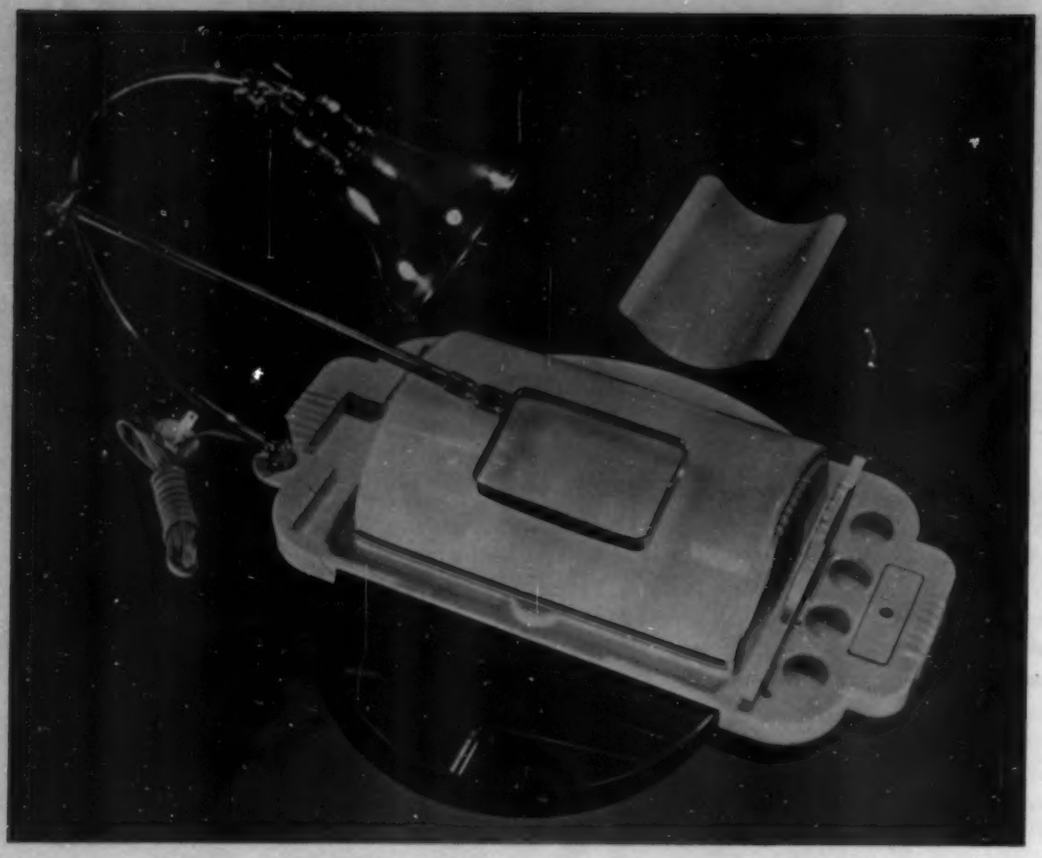
Beauty salon proprietors, operators and specialists in beauty operations who have viewed the unit at recent exhibitions of beauticians' equipment and supplies have been enthusiastic in their praise. Smart and modern in its ivory urea housing, it is destined to be the pride and joy of manicurists wherever they may be.

In many shops, manicuring is an "accommodation" service rendered frequently without profit to the owner of the shop. Yet, girl operators must be highly skilled in the work and well paid. It is tedious work, too, which requires patience, steady nerves, and is generally conceded to be the causes of definite strain on the eyes.

The service is important, however, from the customer's point of view, so that any innovation which will save customers' time, add to their comfort or provide the means of better manicures is naturally of interest to owners, manicurists and patrons alike.

So when the Paulgene company set out to build a unit which would overcome some of the objections to conventional manicuring operations, they studied conditions from every angle. Working on the theory that manicuring is a precision job requiring the same close

Comfort on both sides of the table, precision work made easier for the operator and an easy-to-care-for attractiveness are among the important features of this manicuring unit molded of ivory Plaskon by the plastics department of General Electric Co. for Paulgene Appliance Corporation



Compact and light in weight, the Pro-Care Unit enables the operator to have everything at her finger tips ready for action. The circular drawer, molded of black Textolite for contrast, slides out of sight underneath when not in use

attention and application of the operator as is needed by a jeweler or watchmaker who has to work in a prescribed position and constantly train his eyes on fine work all day long, they planned for maximum physical ease.

Relieving the operator and making her working position more comfortable and tools more accessible was the first step. Providing rare comfort for the customer by removing every possibility of arm or wrist strain was the second step.

Designing a unit that would harmonize with the usual beauty salon backgrounds—be smart and modern; easily used and cleaned; sanitary and lasting in service—brought them to consider plastics. The results are interesting to review. From a functional standpoint, a detailed study of the component parts of the unit had to be made so that the resultant product would be practical as well as appealing to the eye.

Before deciding upon making the device of plastics, the manufacturers gave some consideration to having it stamped of metal. It did not take them long to discover, however, that the cost would be prohibitive; in fact, they claim that if they had made the unit of metal, the finishing alone, whether in enamel or chromium, would have cost more than the plastic material used. In other words, the economy of production was a very important factor in influencing the manufacturer to turn to plastics.

The unit consists of five molded urea parts: the main housing, two covers, a circular drawer, and an arm rest. A catch release located under the larger cover and the grommet on the electrical cord are made of casein. The entire device is scientifically designed to promote perfect customer comfort, with arm, wrist and hand fully at ease for the manicure. The semi-cylindrical shape of the main housing gives complete support to the wrist and by raising the hand from table level facilitates the work of the manicurist and helps to eliminate the hazard of accidents.

On the operator's side, underneath the unit, is a unique hidden drawer. Circular in shape, it contains specially constructed sections to accommodate the various manicuring implements. By keeping each instrument in its individual compartment, dulling of nippers, etc., is prevented, and time is saved by having everything at the finger tips, well in sight as needed. This drawer cannot be opened unless the catch is released. This catch release, a molded red pushbutton, is located directly under the lid on the right side of the unit and when pressed lightly, it releases a hidden steel spring on the underside of the structure.

Built into the right side of the unit are four countersunk cups of oils, lotions and creams. These receptacles are shaped so that the attendant can make use of the last bit of cream, and they can easily be kept clean and neat. Beside these cups is the automatic cotton picker which really is a little magazine that can be loaded with cotton. The cover, which is one of the separately molded parts, is placed on top and snapped closed. The cotton comes out through a small opening in the top center. A larger cover with piano hinge protects

this entire section from dust and keeps it clean.

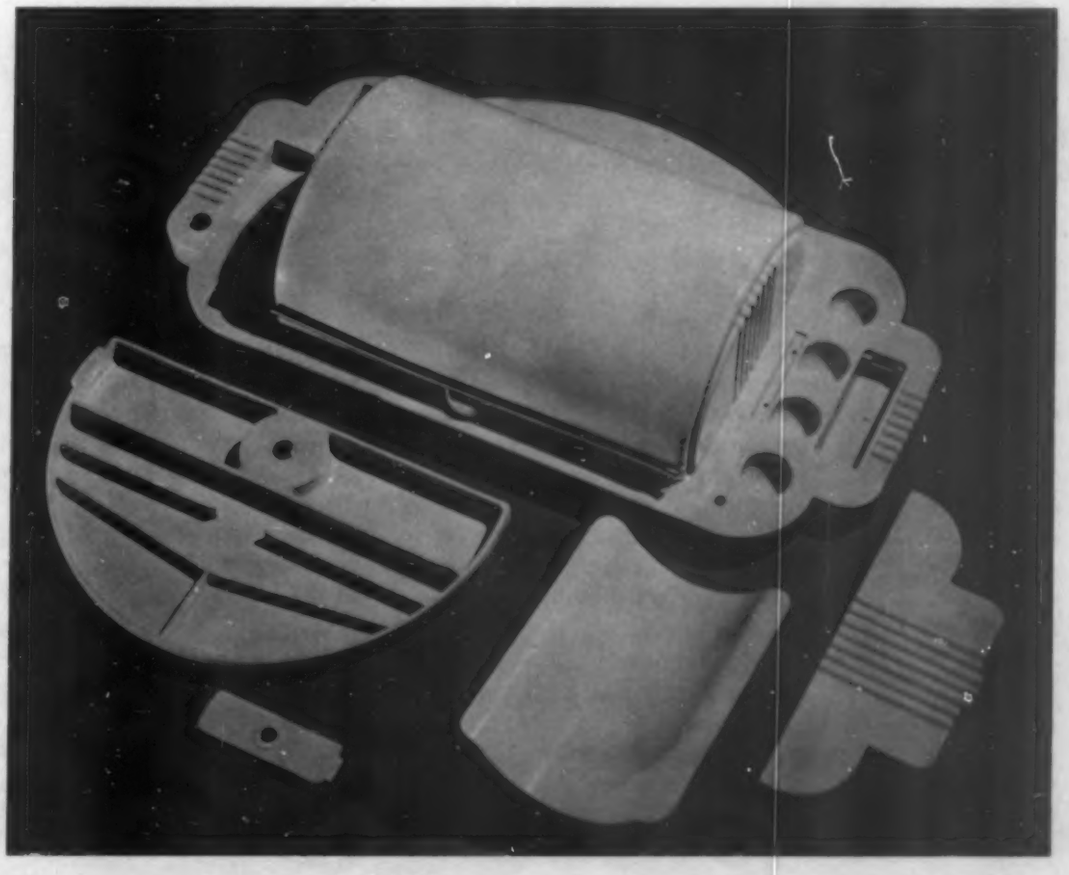
On the left side of the main body structure is a cleverly designed well for nail polishes with a separate well for the bottle of polish remover.

One of the outstanding features of the unit is the arm rest. This simply, but scientifically designed curved portion does much to alleviate body tension, finger tension, slouching and fidgeting. It is equally as comfortable to a long arm as a short one, thin or fat. This arm and wrist rest swings from side to side, and the stud used to pivot this piece is employed in pivoting the circular drawer. It is felt by the manufacturer that this particular device will help increase business.

Customers are not in the habit of requesting hand and wrist massages, the reason probably being that it is so tiresome getting the manicure, that any additional service would be too fatiguing. With this arm rest, however, the client can rest the upper portion of the arm above the elbow, with the greatest of ease. This leaves the lower part of the arm and wrist completely free for the attendant's skill, and at the same time eliminates all discomfort and awkward positions on the part of the patron.

If you have had a manicure recently, you will remember that on the manicurist's table, there usually is a little pillow over which the operator wraps part of a folded towel, leaving the remainder stretching over her side of the table with but a couple of inches used in the manicuring operations. On this new unit, provision has been made for placing the towel where it can be most useful. On the customer's side, there are two little chromium hooks to which the towel is fastened after folding it in half. It falls smoothly over the unit and is fastened under a steel spring on the operator's side. This spring is easily released and placed over the towel, once it is in position. This is not only neater, but it affords the operator the further advantage of having the remaining portion of the towel in her lap, ready for immediate use without wasting time in removing, interchanging and reversing it.

It is quite possible that many manicurists will consider the big lens which serves, as a magnifier, to be the most important accessory on the unit. This magnifying lens is said to be specially constructed to the specifications of an optical specialist and should do much to eliminate eye-strain, backache and general fatigue. The lens has been designed to take in the view of the entire hand without any manipulation. It enlarges, but does not distort. There is no necessity for the operator to lean forward when looking through the magnifier, for it can be adjusted so that from her upright position she looks directly through the lens. This added device should not only enable the operator to work at the manicuring table for hours at a time without showing physical strain, but it is said that it will, undoubtedly, play a big part in encouraging special oil treatments for the nails. If the patron happens to be one of these people who has to be shown before he will believe another's word, he can get a first rate view of his ragged cuticles when the *(Please turn to page 94)*



Five separate pieces were molded for the assembly. All relatively simple in design, the main housing was the most intricate with its decorative motifs and sunken wells. Pushbutton release for the tray and red groumet on the electrical cord are plastic, too

Hard steel wire, automatically fed through this portable gun is completely melted and sprayed against a model where it cools instantly and builds up a complete shell or mold cavity. Where a perfect center is required, the mold can be sprayed upon a model fitted into the chuck of a lathe

Forming molds by spraying metal

Experiments completed, sprayed molds are being tested in production runs

THOSE who have waited months for a mold to be made before an urgent plastic project could be translated into molded parts, have long dreamed of the day when molds could be made in a few hours—or even in a few days, so that their products could reach the market while the ideas were hot.

Even those who spend tedious weeks chipping, grinding and machining molds out of bars and blocks of steel the hard way, may have hoped for a short cut—a more simple method of accomplishing the same result.

Well, someone must have wished upon a star because a new process has been announced which makes it possible and practical to produce molds quickly, accurately and inexpensively, it is said. It consists of spraying metal on or around a form or matrix and then removing the sprayed metal shell which with suitable backing serves as the cavity of a mold.

This process has been under development for a number of years and now the Metallizing Engineering Co., Inc., has perfected it to the point where production molds have been made. Figure 2 illustrates two plastic molds and castings experimentally made by this process which reveal the accurate reproduction of fine details possible to obtain.

Application

The process is reported to be especially adaptable where a great many dies of identical character are required for big runs. Identical dies can be made rapidly from an original master, it is claimed, then set into a chase in the same manner that hobbed cavities are now grouped for molding. Because of the comparatively short time required to make a mold, the process is also expected to prove valuable in turning out sample pieces or short runs which can be market-tested before investing in production tools.

It is said to be possible to get reasonably close tolerances with sprayed metal molds and while they may not be sufficiently accurate for some precision jobs, there are many applications where closer tolerances are not essential to the success of the piece.

The greatest advantage of the process, perhaps, and certainly the most obvious, lies in the fact that finely engraved lines and detailed patterns can be accurately reproduced without the necessity of engraving them in steel. This can be seen plainly in Fig. 3 which shows an original button embossing die (left) and a duplicate die (right) reproduced by this method. The small negative shown between the two positive dies was

made by spraying directly over the original. The negative was then used for making duplicates by the same method.

How molds are sprayed

The molds are made by spraying metal, such as hard steel or stainless steel, bronze or any other metal which can be obtained in wire form, onto a master of the object to be molded (Fig. 1). The metal spray gun used to do the work, and manufactured by the same company, is essentially a small portable foundry. Three gases—acetylene, oxygen and compressed air—are used in its operation. Part of the compressed air is used to drive a small air turbine which feeds the metal in wire form through the gun. The wire is melted as it passes through the acetylene flame and then blown out in very finely divided molten particles and deposited upon the model which is being sprayed.

The model may be made of wood or plaster, which are much easier to engrave than steel, or it can be made of plastics, stone, metal or almost any other material with a smooth hard surface against which the metal can be sprayed. Figure 4 pictures a mold for a rubber tire stem (left) and the model from which it was sprayed.

The sprayed cavities require no heat treating, it is said, and the hardness of the mold depends upon the metal sprayed. Some of these molds are being run now and have been reported to stand up exceptionally well in test performance. The test runs have been sufficiently rigid to determine the practicability of using molding pressures sufficiently high for the successful molding of thermosetting plastics.

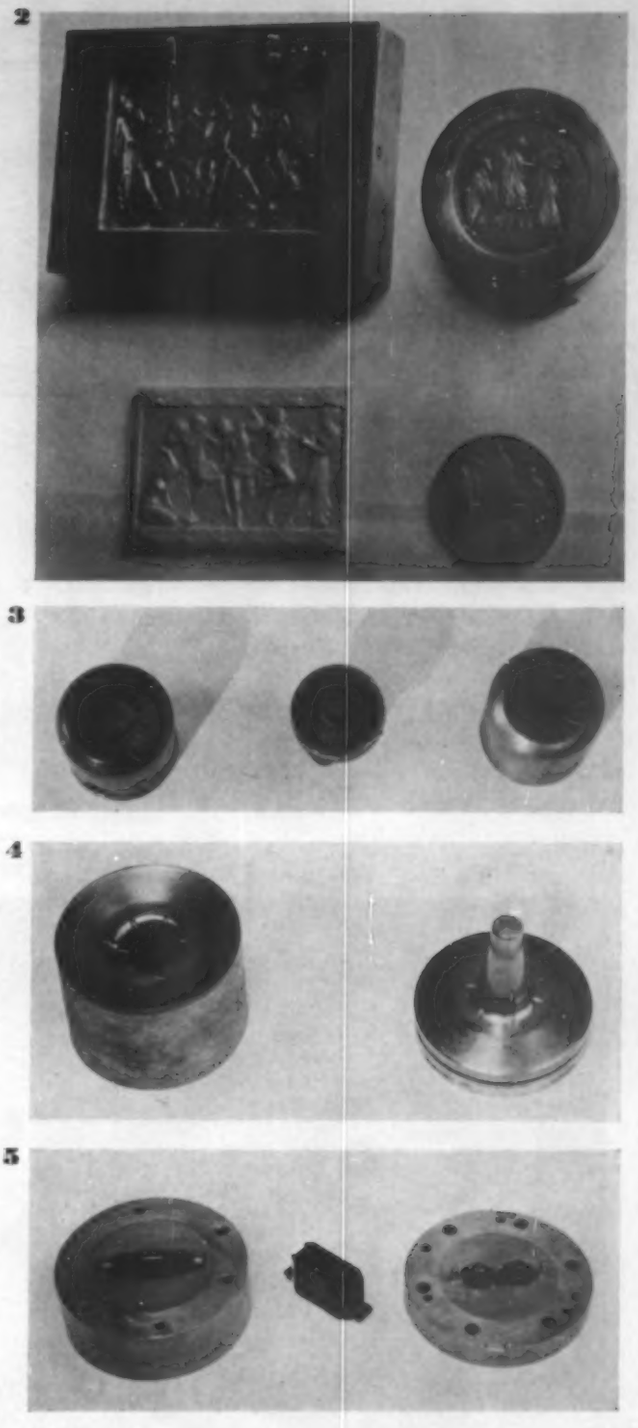
Backing the mold

Backing up the shell to give it stability to withstand plastic molding operations is done by either of two methods—casting or spraying. In either case, the mold is finished by turning in a lathe to get a perfect surface to contact the chase, and the base is either ground or machined to fit.

Figure 4 shows the perfect centering it is possible to get. In this instance the model was mounted in a lathe and accurately centered with the piece protruding from the chuck. Sprayed metal formed the cavity shell of hard steel and the spraying was continued to build up sufficient backing for practical operation of the die. Finishing was simply a matter of turning it down to the proper size while still in the lathe. Metal for backing can be sprayed on almost indefinitely, sometimes up to three or more inches we are told. In other instances it is more practical to take the sprayed metal shell out of the lathe, flux it, and cast metal around it for backing. The choice of method depends upon what sort of backing is required for the completed mold.

How long does it take?

That depends almost entirely upon the size and complication of the die to be sprayed. But usually the time required is exceedingly (*Please turn to page 94*)



Plastic parts 2 with true reproduction of fine detail are produced from the sprayed metal molds above. The small negative of a button embossing die 3 (center) was made by spraying metal directly onto the original (left). Spraying time required for the bronze negative was approximately 4 minutes; and for the duplicate die of hard steel (right), made from the negative, about 5 minutes. 4—A model for a tire stem (right) and the sprayed metal mold made from it (left) indicate the perfect centering possible to achieve by the "spramold" process. 5—From a complete injection type sprayed metal die (left and right) comes a perfectly molded plastic part (center)

Injection molded—2-minute cycle

by DANIEL SZANTAY*

New portable register goes to market with intricate thermoplastic case

THIS new portable register, turned out for United Autographic Register Co., is perhaps, one of the largest and most involved single thermoplastic units ever produced by injection molding. The shell is about 14 in. long, 7¾ in. wide and 4 in. deep. Including the metal bands it weighs 1 lb., 14½ ounces.

Study of the inside view of the case with its ribs, struts, inserts and sprue, will reveal the intricate nature of the design of the mold and will indicate how it was built to provide adequate bracing for stability at all need points.

Cellulose acetate butyrate is used because of its low moisture absorption and resultant dimensional stability, for its free flowing and welding qualities, high impact strength and brilliant luster. This material is molded around the metal reinforcements in one operation. Extreme precision measurements, accurate to within the smallest fraction of an inch, were necessary for the perfect *welding* of the metals and plastics. The molding cycle is about 2 minutes. The only finishing required is removal of the sprues.

The advantages of the new thermoplastic housing over the old one of metal are obvious. For even the best of enamelled or japanned finishes on metal may become marred or scratched in transit and worn during use of the register. Unexpected bumps frequently caused dents and chipping of the finish. Now, with the new shock-resisting shell, scratched or damaged surfaces are easily buffed out with no effect on its brilliant color. The finish is smooth and warm to the touch, and has a degree of per- (*Please turn to page 96*)

* President, Sinko Tool & Mfg. Co.

Designed by Robert D. Budlong, this new UARCO register was engineered and molded by Sinko Tool & Mfg. Co., Inc. (who also made the metal parts) for the United Autographic Register Co. Injection molded on a press of 14 oz. capacity, the housing, weighing 14½ oz., is one of the largest injection molded pieces turned out to date. Tenite II was the material used. Note that an inside metal band around the case and metal inserts were molded in place at one operation

WILLIAM T. CRUSE

E. F. LOUGEE

With this issue I have completed five years' work as Editor of Modern Plastics and very much regret that due to my state of health, I find it necessary to resign.

In leaving, I want to thank those within the industry for their splendid and loyal support during all these years. And I want to thank our readers for their frankness and encouragement which are very deeply appreciated.

My successor, William T. Cruse, hardly needs an introduction. His successful record of achievement with Celluloid Corp. is well known. He is amply qualified by his experience and knowledge of plastic materials and manufacturing methods to carry the service of the magazine forward in a very substantial way.

I sincerely hope he will become heir to the same friendly courtesies you have extended to me — and for which I am duly grateful.

As always, E. F. Lougee

1

2

Weather-resistant phenolic base paint in deep pink, coating Tourneur's front door **1**, *keynotes the colorful modern interior. Set against the wall* **2**, *are chairs with seats and backs of webbed Vinylite strips. Four prints mounted on the plaque above are sandwiched between thin Plexiglas sheets. Circular disks of this plastic support the glass table top*

Cleopatra would have adored this

by JUNE GUNCHEON

DOWN through the ages lovely ladies have been paid the compliment of having gracious surroundings styled especially for them. Cleopatra, however, had nothing on our Twentieth Century beauties when it comes to palatial environment.

Designing a beauty salon, however, is a ticklish job. The designer must not only have an eye for elegant appointments, but he must always remember the maintenance problems of the owners. This business of upkeep in a make-up salon is a costly one, and demands careful consideration.

Fortunately, the manager of the new Tourneur Make-Up Salon, New York, will have no such worries. Morris Sanders, architect, and designer of the shop has left little room for anything but favorable comment. This beauty salon is but one of the many shops the company operates throughout the United States and in England. The firm claims it was the first to apply "synchromonic" principles to individual make-up blending, a method which they say they originated more than ten years ago.

Although the actual floor space of the salon is small, an air of spaciousness has been achieved by the fine selection of colors and the general effect of crystal created through the use of plastics and textural glass.

As far as the interior designing is concerned, the keynote is probably the featured color, Persian pink, which incidentally, is one of the colors figuring so prominently in the current exhibition of Persian art.

The color is introduced quite dramatically at the entrance (Fig. 1) where the door is painted a lovely, rich shade of this color. As we step inside, we sense an air of elegance shot with a streak of spontaneous gaiety, the latter probably derived from the ceiling—a

lighter tint of the pink. To the right is a curved couch, and right here we find a brand new use of plastics (Fig. 3).

The couch is covered with a satin fabric that exactly matches the color of the ceiling. This is over-laid with white lace—reminiscent of the antimacassar days when every parlor boasted a set on every chair and sofa. The entire couch—pink satin, lace and all—has been upholstered with highly plasticized vinyl resin sheet material that is soft, resilient, and almost rubber-like in texture. The plastic is transparent and because some of the air bubbles were allowed to remain even after the calendering process, it seems to have a fine, grained design that is almost invisible except when looking at it from certain angles. The plastic, of course, affords permanent protection to the sofa.

This type of plastic has been used in various forms throughout the salon, and we shall discuss these applications as we come to them. The fact that the material is not only adaptable to decorative use, but possesses durable and practical qualities as well, makes it highly worth while for fine interiors.

Next we come to the make-up bar which has been upholstered with a fiberglas fabric in a basket weave design, then covered with the vinyl resin sheets. The transparency of the plastic permits the weave of the textile to show through—an added decorative note—while, at the same time, the material is almost foolproof in its resistance to grease and stain. The cushioned effect achieved by using this plastic at the make-up bar should have a very definite sales appeal. It's pleasant to touch, and a delightfully comfortable place on which to rest the elbows, if that sort of reclining is permitted at a bar for beauty!

But when it comes to real comfort combined with beauty, the chairs have it! Simple in design, but very lovely, they are made of pickled oak, the wood used throughout the salon. Strips of the plastic about 2 in. wide, cut from sheets of vinyl resin, are used horizontally and vertically to form a webbing for the seat and back. Here again we perceive a grain effect, simulating leather, which not only reduces the transparency of the material, but imparts a frosty quality that is refreshing and lovely. A delicate pink cast in the plastic hints at the omnipresent feeling of *joie de vivre* so characteristic of the entire shop.

The salon is air-conditioned and the indirect illumination has been scientifically planned for comfort as

Near the front of the salon **3** ***is a curved lounge upholstered in plastic. Styled like Grandma's horsehair sofa, pink satin with a white lace overlay is covered with clear vinyl sheeting. The circular coffee table is surfaced in chalk white Formica. Overhead a suspended lighting fixture, shielded with sheets of Louverglas, casts a soft diffused light***

3

well as efficiency. At the make-up bar (Fig. 5), day and night mirrors have been designed to counteract the greenish and greyish tones which mirrored glass imparts to the skin. Exact daylight is reproduced by means of colored lumiline bulbs. At the turn of a switch, filament bulbs produce the effect of night lighting. Curved sheets of an acrylic resin in white, translucent form have been used for the shades of the lights on either side of the mirrors. Above the circular couch in the front of the salon is another long lighting fixture suspended from the ceiling. In this instance, the glowing tubular bulbs are shaded by another plastic, a cellulose acetate that has been specially designed for lighting purposes. This material appears to be finely striped. These fine lines or stripes, however, are the result of building up alternate layers of opaque and transparent plastic in one of the early manufacturing stages, then slicing off the sheets so that the striped effect is obtained. In some cases, the layers are built up at certain angles, this variance being dependent upon the lighting effects and control of transmission desired. There are five curved white sheets used for this fixture. Panels of this same plastic have been employed to conceal the lighting tubes located just behind the three large wall plaques decorating the wall opposite the make-up bar. The acrylic material is found again in the tables which grace this wall. Circular disks in crystal-clear form are used to support the plate glass top of each table. The window display on the street features one of the decorative scales that have recently become so popular, and this, too, is made of a transparent plastic.

The plaques, shown in Fig. 2, are panels covered with handmade marbleized wallpaper. On these are a series of Raoul Dufy prints in gay colors. These prints have been cut out and sandwiched between two sheets of acrylic material and placed in pickled oak frames. This particular plastic was chosen, not only because of its unusual clarity and brilliance, but because when finished, the framed prints could be mounted upon the backboard without splitting or breaking, which would not have been the case had glass been used. The effect is as if each picture were suspended in mid-air.

Still more plastics are found on the service bar, or shelf (Fig. 4), directly behind the make-up bar. Here, the various cosmetics are mixed by the attendants. A laminated material in a marbleized pattern of beige and various tints and shades of brown is used for this surface, as well as for ledges and shelves in other parts of the salon. Stepping behind this counter, we find

Behind the counter 4 cosmetic mixing bowls are set into washable shelves surfaced with Formica. Top drawers in the counters are lined with Vinylite sheets to protect them from the onslaughts of grease and cosmetic stains. Mirror lights are shaded with translucent sheets of white Plexiglas

4

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Comfortable, cushiony upholstery on the make-up bar **5** *is easy on the customer's elbows and is cleaned by simply wiping with a damp cloth. On the left wall* **6** *very thin sheets of vinyl have been draped in a swag effect directly above each filing cabinet. More than decorative, they function as practical light softeners. The flooring is grey marbleized Flexachrome, a vinyl-derived material*

vinyl resin sheets creeping into the top drawers as linings. In this instance, the material is a little more familiar, since it is the unplasticized type that is frequently used for book bindings, radio dials, drawing instruments, etc. Here, however, it serves an entirely different purpose: should any of the creams, lipstick or creme rouges spill, the drawers can be easily wiped out without leaving any stain or trace of color.

The wall on this side of the salon is covered with a gold and white striped paper, and against it are the utility cabinets and files, modern in design and made of pickled oak. Above each cabinet is a length of material that appears to be very fine silk. The material is not silk, however, but very thin sheets of highly plasticized vinyl resin draped in a swag effect and acting as a light softener for the filament bulbs concealed behind each cabinet.

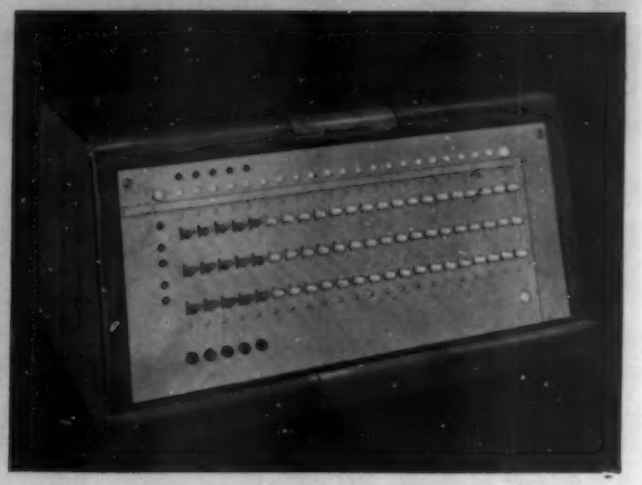
Another practical touch of plastics is the chalk white laminated top of the modern circular coffee table in front of the sofa.

Thus far, we have talked about the ceiling, the walls of beautiful wallpapers and textural glass, the furniture and other furnishings, but what about the floor? Well, that's plastic, too! A vinyl resin flooring material was selected. The outer portions near the walls display a black and white marbleized pattern, while the sections in front of the make-up bar harmonize in tones of grey. A block pattern is used here, alternate blocks of solid grey contrasting with blocks of marbleized darker shades. The plastic contributes comfort under foot, beauty and durability (Fig. 6).

And that just about finishes our tour of Tourneur. But let's take another look at the display window on our way out. Besides the acrylic balance, there are some other plastics in there. That acetate figure of the woman's head in the corner has the most exotic looking hair. No wonder, it is made of long, glistening strands of vinyl resin. These extruded strands, although transparent and colorless, appear to have a delicate lavender quality about them. An eye mask on the head is pink, and made of the same striped plastic as that used for the over-head lighting fixture inside. Even the applied eyes and cheeks are of cellulosic plastic.

The extruded plastic strands, by the way, have been rather ingeniously used, we are told, by the designer of the attendants' gowns. Rita Fisher, who designed the grey frocks, has used this plastic for the bodice lacings. The belts are of strips of the same material. And if you look closely at the side of the mirror just inside the door, you will see a braided piece of the extruded strands used for the light pull on the long, filament bulb above the mirror.

From furniture, to floors, to bodice lacings—maybe the person who said that plastics were an inspiration to industry wasn't so far wrong after all! At any rate, they are certainly playing their part at *Vanity Fair*.



Frederick S. Grover and Associates, collaborating with Stromberg-Carlson engineers, have given these two new switchboards a clean, efficient appearance backed by scientific perfection in operation. The refinishing stock, mentioned in the article, was made by Formica Insulation Co.; the fiber panel insert, by Spaulding Fibre Co.; the colored key handles are Ameroid

Number please

TWO new switchboards in the Stromberg-Carlson line of telephone equipment make generous use of plastic materials. Both of these switchboards, completely redesigned, incorporate the latest mechanical developments and circuit improvements from Stromberg-Carlson's research and engineering divisions.

Special emphasis has been given to the reduction of operator fatigue. Simplified physical and mechanical layout has gone a long way toward that end but one of the greatest gains comes through the use of color to produce restfulness.

The cabinets are walnut to harmonize with a majority of the modern office decorative schemes. The form is the simple, classical combination of curves, soft edges and straight, functional lines. In contrast is the clean relief of the buff-colored face and keyboard, broken only by the chocolate-brown, fiber insert in the plugshelf section. There is a pleasant orderliness about the arrangement of the operating keys, plugs, and jacks while the bright spots of color—red, white, and brown—in the lamp caps and key handles accent its modern face.

A major difficulty was encountered, we are told, in obtaining a suitable plastic for the face and keyboard. All available materials capable of providing the desired color, it was claimed, were found to be lacking in one or more of the exacting strength characteristics.

It remained for one of the laminating manufacturers to develop for this purpose what is called *refinishing stock*. It is made *refinishing* by the use of pigmentized paper impregnated with varnish; all sheets of the assembly are made from this material and impregnated with the same type of resin. This is possible only by introducing the color pigment into the pulp when the paper is being made. By impregnating such a sheet with the proper amount of resin, the core is made uniform and therefore *refinishing* throughout its thickness.

Recent developments in urea resins—improvements in their water-resistant characteristics—made the final result possible in the light color that was required. Fadometer tests by the manufacturer show no change in color and in their opinion, "when properly combined with suitable paper and pigment, will not check, crack or change chemically over a long period of time."

The several colors used in the key handles are machined from casein rod stock and the fiber panel insert gives additional wear resistance around the plugs.

Eclipse to order

SCIENCE is very helpful these days in making life pleasant and agreeable to live. It provides so many conveniences which add to our comfort and health that we should be grateful indeed.

The latest innovation, in which two types of plastics are contributing factors, is the Polaroid Variable Day Glass which permits the wearer to control the brightness of the view. Unlike any previous device, the new Day Glass makes any brightness right for any normal eyes by simply moving the regulating button (Fig. 1) from side to side.

Each eye looks out through two polaroid lenses. The front lens before each eye is stationary in the frame, while the two rear lenses may be rotated by a convenient button on the bridge of the frame. When this control button is moved to the extreme left, the maximum amount of useful-seeing light reaches the eyes (Fig. 2). As the button is moved towards the right, the glasses become gradually darker and darker (Fig. 3), until at the extreme right they are so dark (Fig. 4) that the brightest possible surrounding landscape can be viewed with no discomfort whatsoever. Between these two extremes of adjustment lies an infinite variety of densities—at least one of which is sure to fit the eyes.

In addition to their revolu- (*Please turn to page 96*)

A simple control button 1 revolves the inner lens on both sides of these new Polaroid Variable Day Glasses so that the maximum amount of seeing-light 2 may be reduced to become gradually darker 3 and darker 4 until complete comfort is achieved. A louvered plastic shield permits side vision while blocking all back reflections

1

Plastics are everywhere in this special grouping **1** *of Plastics, Ceramics and Glass home accessories at the Metropolitan Museum of Art exhibition. Formica surfaces, wall panels and shelves. Clear Plexiglas posts made by Vazah, Inc., support a chain of bulky beads turned from Monsanto Cast Phenolic by Ortho Plastic Novelties, Inc. Transparent Lumarith drums enclose the silhouette a-top the circular case. Plastic radios, clocks, sculpture and lamps sit on the shelves*

American industrial art

by HARRIET JOSEPHS

Modern designers create decorative functional home furnishings with plastics and other new materials

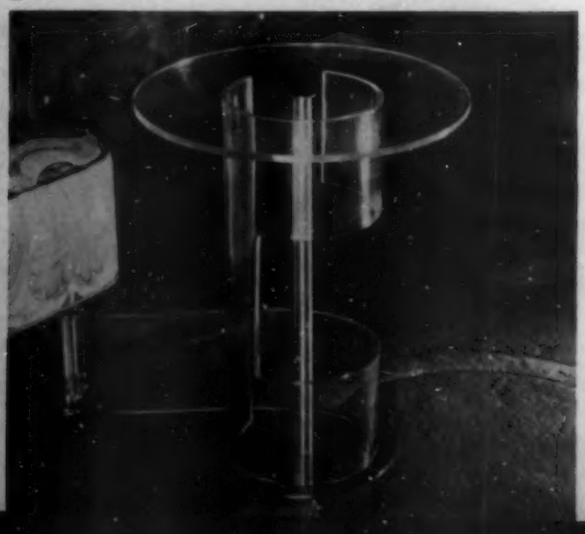
THE Fifteenth Exhibition of Contemporary American Industrial Art, sponsored by the New York Metropolitan Museum of Art, opened in the Special Exhibits Galleries April 30, and will run on through September 15, 1940.

It is significant to note in this dramatic presentation of home furnishings that a large proportion of the objects displayed is designed for general production, although not yet released on the market. Here is an honest effort on the part of contemporary designers, architects and decorators to meet the needs of the American way of life—and they have turned to modern materials to create the new mode.

The extensive use of a variety of plastics in this representative cross section of modern industrial products is ample evidence of contemporary craftsmen's awareness of the versatility of the synthetic resins. The approach of designers to plastic materials in these pieces not only suggests new, practical, effective uses but also indicates the spread of chemical products into new channels, many never visualized by the laboratory worker, inventor or chemist.

2

3



For the special Plastics, Ceramics and Glass setting (Fig. 1), supervised by Arthur L. Harmon, and planned by Leon Solon, Cora Scovil designed an ornamental chain barrier to set off the display from the main passageway. This consists of clear plastic posts, fabricated from acrylic rods, placed at intervals along the edge of the platform. Each post is topped with a graceful opaque hand. A rope of huge tortoise-shell beads, turned from cast resin, joins adjacent hands.

A brilliant inlaid panel of laminated plastic, designed by Boris Artzybasheff, covers the left end panel of the display and the same plastic is used for the plain counter shelves and panels. Set in one of the upper display panels, Charles Connick's colorful allegorical mosaic of plastic and leaded prismatic glass (Fig. 10), illuminated from behind, simulates Gothic stained-glass.

Among the sculptural pieces in this grouping are a modern "Madonna and Child" by Helene Sardeau and a dainty, translucent figurine (Fig. 5) by the Allings, called "Devotion." Both are of phenol-formaldehyde resin cast in rubber molds. Raymond Barger has carved a plastic abstraction (Fig. 7) from clear acrylic sheet, taking full advantage of the edge-lighting and light-diffusing properties of this material to create a musical rhythmic effect.

Attractive timepieces of plastic material move from the kitchen into the decorative sphere. A wall clock

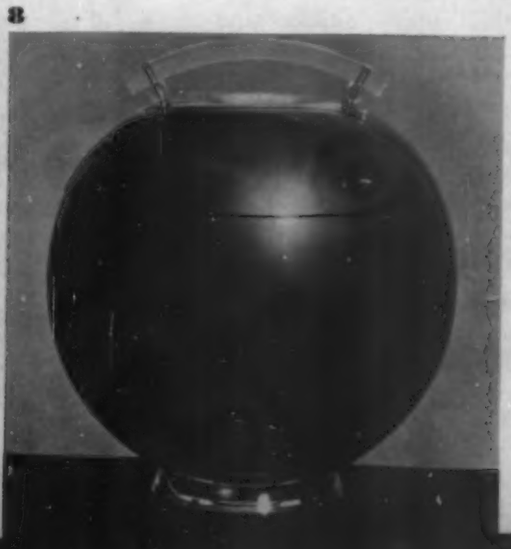


Table tops in this gay nursery 2 are of white Formica. Geometric forms of Monsanto Cast Phenolic are suspended in lighted wall niches. Cast resin stars are used for stove handles. This swirling Plexiglas table 3 was fabricated by Swedlow-Lehman. An entire wall, near the fireplace of this living room 4, is of maple Parkwood-Textolite. The same laminate, in mahogany veneer, tops the modern Stewart-Warner radio-phonograph at the left. The lamp shade is of translucent ivory Lumarith. Eric Alling cast the tiny figurine 5 of Catalin. A graceful chair with back and seat of interlaced Lumarith strips and a black Formica table brighten the terrace 6 by Nessen Studios. The sculptural abstraction in the corner, formed by Classic Studios, is of bent transparent Plexiglas sheet and the plaque 7 was carved from that material. Bernard Rice & Sons fabricated a handle and base of Lucite for the insulated ice tub 8. A unique Seth Thomas clock 9 by Accessory Timepieces is housed in the same clear acrylic plastic

10

"New England Fantasy"—a Coloralight mosaic of jewel-like glass and plastics **10** *pictures an allegorical tale of a Yankee who shot a mermaid. Prismatic glass in sharp patterns are held in place by stout metal bands and the entire unit is illuminated by a controlled flow of fluorescent lighting from the rear*

11

Molded in maroon Tenite with contrasting colored knobs, this new Philco table model radio cabinet **11** *achieves distinction through simplicity and adaptability of design*

of transparent phenolic by Ruth G. Kosmak and Henry Adams Grant has bright red plastic beads serving as clock face numerals. Clear acrylic disks mark the hours on a zebrawood clock designed by Morris Sanders. William A. Kimble and Camille B. Lehman have produced a unique seven-day clock (Fig. 9) housed in a case of crystal-clear methyl methacrylate which picks up highlights of the brushed gold dial and smoky blue enameled hands. The 11-jewel movement is a visible decorative feature as well as an essential working part.

Plastic radio cabinets, unusual in design and color treatment, are represented by a phenolic case styled by Ruth Kosmak and Henry Grant and a small, cellulose acetate housing designed by Alfons Bach (Fig. 11). There are candle holders of cast resin created by George F. Snowden; lamps of specially treated acetate designed by Walter Loos; mirror fixtures of clear methyl methacrylate and metal by Cyrille Steiner; and fish swim in Marianna von Allesch's aquarium which is set in a plastic base.

Topping the circular display case at the right of the display (see Fig. 1) is a silhouette by Ugo Mochi that graphically depicts the art of making pottery. Two drums of transparent cellulose acetate, about 4 feet in diameter, one inside—the other outside, support and cover the silhouette, giving its black figures greater clarity and depth.

Ely Jacques Kahn has used plywood for the walls and display case of the Metals and Glass exhibit, which has several novel floor plaques of laminated plastic designed by Alice Donaldson. These plaques have colorful pieces of bright fabric arranged in decorative patterns, pressed into the uppermost layer of the plastic lamination. Clear methyl methacrylate handles dress up a dainty dresser set and an apple-shaped crimson aluminum vacuum tub (Fig. 8), both designed by Mr. Kahn.

In a modern living room (Fig. 4), Gilbert Rohde has placed a radio-phonograph combination suitable for homes furnished in period or modern styles. The top of the cabinet is of woven wood laminate—mahogany veneer strips woven into a marquetry pattern, and impregnated and surfaced with plastic resin. This same type of material, in a basket weave design of maple veneers covers part of the wall of the room. Ivory translucent cellulose acetate shades an adjustable reading lamp. Chair cushions and backs are of rubber and latex covered in bright fabrics.

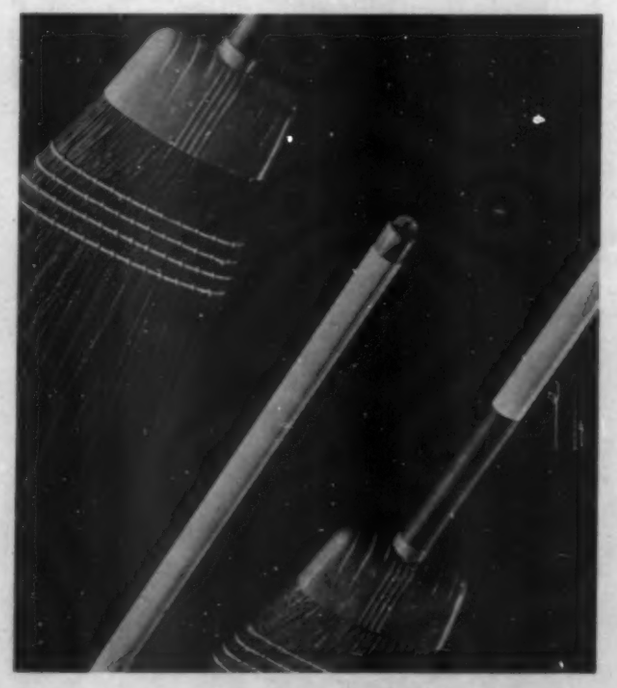
Eugene Schoen has interpreted suave elegance for a living room in a circular smoking table (Fig. 3), formed of clear acrylic and in the draperies of glass fabric. Books, furniture and rug are waterproofed to withstand inclement weather, as the room adjoins an open porch. Walter Von Nessen has carried out the luxury of the inner room in the furnishings of the porch (Fig. 6). The terrace chair has a base of gold metallic finish and the sloping seat and back are made of transparent cellulose acetate strips interlaced in a rustic basketry pattern. The coffee table is surfaced with a smooth, durable laminated plastic. In the corner, there is a sculptural abstraction, called "Bird of Fantasy," by Robert Foster, which is made from bent transparent acrylic sheets.

Background materials, selected for ease of cleaning, toughness and color are used in two nursery rooms. Desk and table tops of white plastic laminate in Raymond Loewy's combination sleeping, study and recreation room (Fig. 2) for a girl of five, are sanitary and bright. For decorative and educational interest, there are tiny fundamental geometric symbols, fabricated from luminous plastic, set in illuminated wall niches. Heat-resistant, star-shaped handles of cast resin dress up a miniature Swedish tiled stove. Kodachrome enlargements, illuminated by (*Please turn to page 94*)

Cheerful pastel hangers and shoulders of molded Tenite dress up Rich & France, Inc.'s, new house broom (below). The smooth plastic parts won't scratch furniture and are tough in service. They're injection molded, 4 sets on a single sprue (right) by Elmer E. Mills Corporation

5000 dozens sold in 8 weeks

First modernization of the lowly broom in nearly fifty years brings hearty buying response



ABOUT a year ago, Rich & France, Inc., decided to take advantage of plastics and color to boost their whisk broom business. Now they have carried their idea a step further and in March, this year, introduced the entirely new full-size pastel broom illustrated at the left.

The response was immediate and enthusiastic. Five thousand dozen brooms were sold in less than eight weeks and as this is written, orders are coming in such volume that the company reports that it is five weeks behind in deliveries.

The popular acceptance of color in kitchen utensils and home appliances no doubt gave impetus to the immediate success of the pastel broom and the durable colorful plastic shoulder and hanger add months of continued good appearance in service as well as lightness in weight. Besides, the plastic color goes all the way through and cannot chip or dent.

The molding itself (above) is an interesting example of the progress that has been made in engineering design. There are four cavities of each part on a single sprue and the molding is done by the injection method on an 8-oz. machine. That means (*Please turn to page 100*)

1

2

3

GRIP-TUTH
HAIR RETAINER
GRIP-TUTH
GRIP-TUTH
RETAINER

4

5

6

7

ACOUSTICON

8

Plastics in Review

1 Fragile-looking flower stands formed of crystal-clear Plexiglas rods are cool and dainty centerpieces for spring tables. Tiny place card holders, napkin rings and cigaret trays to match. All are fabricated by Croasdale and de Angelis

2 A tool that drives and draws screws, drills holes—North Brothers' Yankee Handyman spiral ratchet carries accessory parts in a transparent magazine handle. Designed by Egmont Arens and molded by American Insulator Corp., the handle is made of a special Tenite compound to withstand extreme heat or cold

3 Change the color of your pipe to suit your smoking mood. Colorful, transparent interchangeable Lucite stems allow a clear view of the patented Ken mechanism for condensing and collecting moisture, tar, nicotine and impurities. Bite is thin, easy on the teeth and lips and won't fade. Elmer E. Mills Corp. molds the stem for Kenilworth Pipe Company

4 Coiffures go up and tiny, split-tooth tuck combs hold stray curls in place. Spreading teeth prevent their slipping up and down in the hair and the smooth ends will not injure the scalp. Diadem, Inc., molds the combs of Lumarith

5 The peak of convenience—a conical combination top dispenses salt and pepper from one shaker. A small separate magazine for pepper screws into the threaded cap near the top without interfering with the flow of salt. Boonton Machine Co. molds it of ivory Beetle

6 Comfortably warm crisper tray handles of blue contrast with the snowy white refrigerator surface. They're molded of Tenite by Thermo-Plastics and the Gibson trade name is inlaid in silver by Plastics, Incorporated

7 Acousticon, Dictograph Products Co.'s lightweight hearing aid, is completely housed in self-insulating plastic that's unaffected by direct contact with body heat or moisture. Bridgeport Molded Products Co. molds it of Durez. Both bone conductor and standard ear type receivers are available

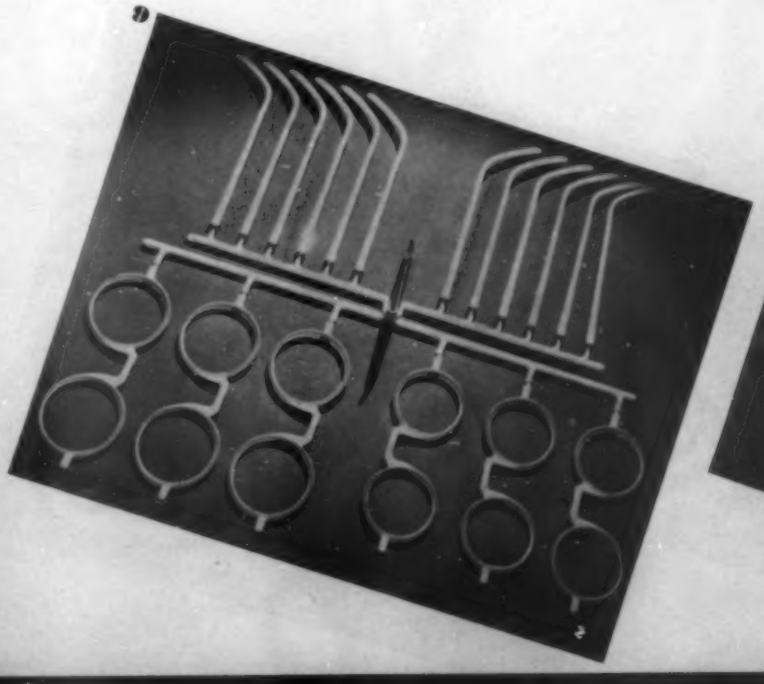
8 Accenting the tapered waistline—a studded belt of transparent Monsanto cellulose acetate lets your dress color show through, and there's no extra bulk. They're made in stripes, two tones, etc., by Zinglass Products Co. of America

9 Six pairs on a single sprue—sun goggle frames, both front and temples, are being molded by Imperial Optical Co., Canada, on a Lester injection press. The mold, by Guy P. Harvey and Sons, is made in sections so that any one of the four parts can be "blocked out" if desired

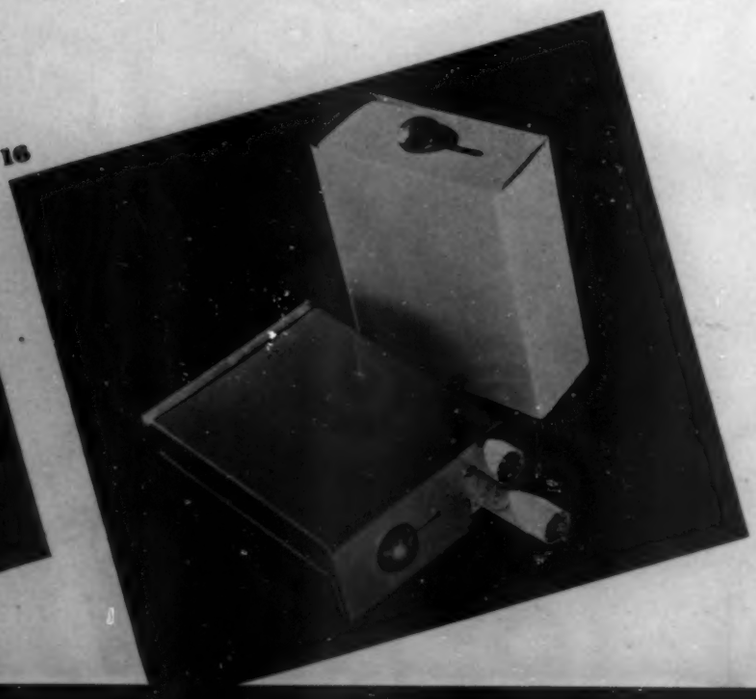
10 Run the world your way. H. V. Kaltenborn's Diplomacy game gives you a chance to play for "empire" stakes. Gaily colored Bakelite cast resin playing pieces are fabricated by Industrial Plastics Corp. for the Trend Game Company

11 Wind in your hair and you'll want to reach for this illuminated automobile vanity mirror which clamps onto the sun visor. Light bulb is encircled by a small shell-colored plastic ring, serving as a switch, which is set into a wide band of translucent beige plastic. Both are molded of Lumarith by T. F. Butterfield, Inc., for Joseph Pollak Corp.

12 A clean, white disk of Plaskon tops polished aluminum rods in the Vogue model Rittenhouse door chime. Molding is by Diemolding Corp., and design by F. S. Grover and Associates



Plastics in Review



13 Smooth, transparent amber plastic molded directly around a metal shaft forms a rigid, low-heat conducting wrench handle. Virtually one-piece, the unit needs no screws, rivets, etc., for attachment. Molded of Tenite by Philadelphia Electric Company

14 Handy for home or outings, Dur-X juice extractor fits into the stem end of fruit and extracts and strains in a jiffy. Plastics, Inc., molds it of clear Bakelite cellulose acetate for Kitchen Gadget Mfg. Co. It's grand for coring, too, and is unaffected by fruit acids

15 Black and onyx ink-resisting Tenite II combine effectively in the neat Regal dip-pen set. A glass ink bottle is completely covered by the cylindrical cap. Plastic parts are molded by American Insulator Corp. for Turner & Harrison Steel Pen Mfg. Company

16 Featherweight cigaret package covers, suitable for low-cost premiums, are fabricated from tough, heavy Dow Ethofoil sheet by Browne Engineering Co. A sliding cover keeps the pack fresh. Advertisments can be imprinted

17 Miniature showcase, for counter top or window, displays eight attractive items of the Houbigant cosmetic line. A transparent, semi-circular canopy of Monsanto Vuepak keeps out dust and affords a clear view from all sides

18 Carefully locked against little sister's sampling, Tres Chic perfume bar "sets up" three 2-dram bottles of intriguing scent. Athol Comb Co. molds it in five gay shades of Lumarith for R. C. Nathan & Company

19 Dainty, pastel dustproof ring boxes of molded plastic, made for Wolfsheim & Sachs, Inc., replace velvet and plush cases. The acetate hand was used by Revlon Nail Enamel Corp. as a premium and souvenir pin. All are by Norton Laboratories, Incorporated

20 Signalling danger with familiar red, green and yellow color symbols, Anderson Co.'s Charge-Master forewarns car users of electrical disorders, battery irregularities, etc. Barnes & Reinecke designed the device and its two-piece case, injection molded of Lumarith by Elmer E. Mills Corp., clamps to the automobile instrument panel

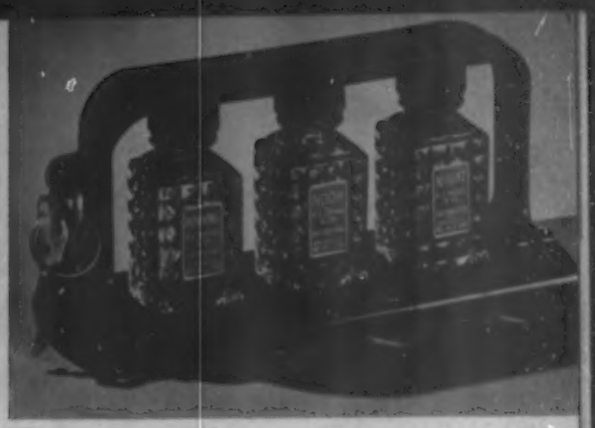
21 Telephone numbers at a glance—Precision magnifying lens of Lucite, set in a metal letter opener, covers the full width of the directory column. Made by K.-D. Mfg. Company

22 Lightweight substage lamp for examining microscope slides and specimens is completely molded of black Durez. Back is louvered for ventilation. Front, containing blue glass lens held by a spring, is snap-fitted to the main housing. Plastic bulb holder unit slides into molded-in slots in the back. Marmont Plastics, Inc., molds all three parts for Clay-Adams Co., Incorporated

23 Valdor, Inc., has added a Plaskon rouge container, molded by Universal Plastics Corp., to its Don Juan cosmetic line. The lipstick case was an award winner in the Fourth Annual Modern Plastics Competition. Design is by J. Havlik

24 To promote Florida tangerines, Florida Citrus Commission packs them in a transparent basket, imprinted with a bright label. The container is Monsanto Vuepak, fabricated by See-Thru Container Corporation ■

17



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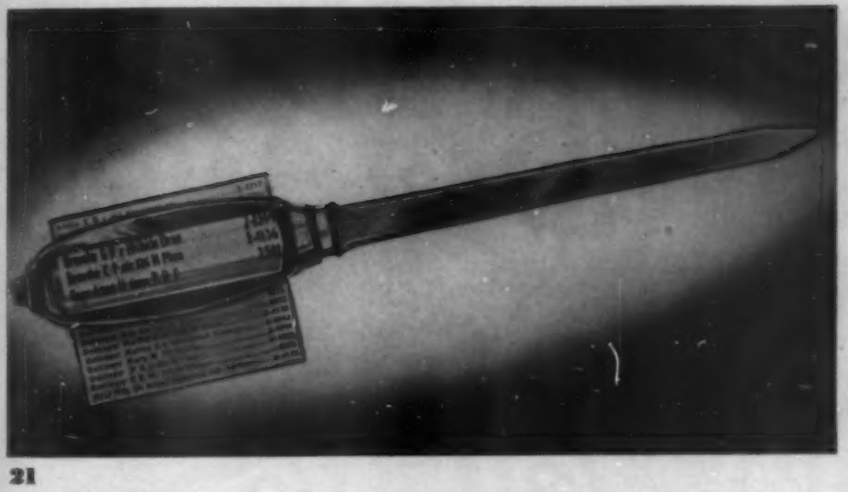

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My goodness..

IT'S A NEW CONTAINER developed by the Elmo Sales Corporation for its Ralo powder. With the aid of Molded Plaskon, beauty and utility have been combined in this object of art for Milady's dressing table.

Striking in appearance is the Ralo container, with its ivory cover complemented by the blue base. In the center of the cover top, a rich molded floral design surrounds the engraved "Ralo" name. The entire decorative motif is set off by a background of beautiful blue.

And for practical purposes, Molded Plaskon serves Ralo needs to a fine degree. The cover is air-tight, preventing moisture from caking the powder, and preserving its delicate and elusive fragrance. The powder cannot sift through the base or cover, thereby helping to keep clean the surface of the dressing table.

Is the appeal of *your* product directed to women . . . to men . . . to both . . . or are you interested in greater manufacturing advantages?

Then investigate the features of Molded Plaskon. It is smooth and warm to the touch. Though light in weight, it has great strength—will not chip, corrode, rust, or tarnish. Its surface is hard, easy to keep clean. Water, oils and organic solvents will not stain or otherwise affect the beauty of Molded Plaskon. Being solid molded color, the finish is permanent. Neither scratching nor abrasion impair its color value.

These are but a few of the many distinctive qualities that have made Plaskon the world's largest selling urea-formaldehyde plastic—and one of the most versatile.

Ask us for suggestions on how Molded Plaskon may be able to give *your* product new shelf appeal, eye appeal, *sales* appeal! A letter or wire will bring a Plaskon representative quickly.

PLASKON COMPANY
INCORPORATED
2121 SYLVAN AVE. • TOLEDO, OHIO
Canadian Agent: Canadian Industries, Ltd., Montreal, P. Q.

how gorgeous!

This is the distinctively beautiful Ralo powder box, designed for feminine appeal. It is molded for the Elmo Sales Corp., Philadelphia, Pa., by the Armstrong Cork Co., at its Lancaster, Pa., plant. • The Ralo powder box measures 3⅝" in diameter across the base, and is 2⅛" high.

Trade Mark Registered

PLASKON

★ MOLDED COLOR ★

Plastics in Peru

(Vice Consul David M. Clark, Callao-Lima)

This is the second of a series of surveys issued April 1940 on South American trade in organic plastics being undertaken by the Bureau of Foreign and Domestic Commerce, U. S. Dept. of Commerce to aid United States manufacturers, secure orders for such products and for machinery used in fabrication. The first of this series was published in the May 1940 issue. (Editor)

DOMESTIC production of articles made of plastic materials is small, consisting of one comparatively important manufacturer of cups, plates, saucers, and tumblers which are used principally for picnics. In the manufacture of these articles a compression molding machine is used. Up to the present time there are no injection molding machines in Peru. There are two small workshops manufacturing buttons, brooches, buckles, and clips from protein plastics, such as galalith, which are imported chiefly in sheets. In the manufacture of plates, etc., by the electric pressure molding process, the prime material which has been used up to the present consisted principally of a German synthetic resin in powder form known as "Polopas."

It is estimated that plastic articles produced by pressure molds consist of approximately 10,000 units annually, while the consumption of synthetic resin types, such as galalith, for the year 1940 will run in the neighborhood of possibly 10,000 kilograms. The estimate is given for 1940 because the smaller firms have been established less than a year and imports during the past two years have been largely for experimental purposes.

All plastic articles are made from imported materials.

Distribution—Domestic manufactured plastic articles are marketed direct by the manufacturers to the retailers.

Plastic prime materials are sold to the manufacturers through the medium of a commission agent or branch distributing office.

Imports—The following statistics will afford an idea of the extent and size of the Peruvian plastic industry:

Imports of galalith for the manufacture of combs and the like.

Country of Origin	1937 Volume (Gross Kilos)	1937 Value (Soles)	1938 Volume (Gross Kilos)	1938 Value (Soles)
Germany	750	1,436	308	1,295
Chile	44	115	45	211
United States	...	...	124	366
Total	794	1,551	477	1,872

Imports of galalith during the first ten months of 1939 amounted to 2,989 kilograms valued at 10,674 soles.

The following custom classification would probably cover synthetic plastics for pressure molding machines; however, the percentage of the imports representing various materials would be difficult to determine.

Imports of organic natural or synthetic products not specified.

Country of Origin	1937 Volume (Legal Kilos)	1937 Value (Soles)	1938 Volume (Legal Kilos)	1938 Value (Soles)
Germany	6,267	115,475	9,247	169,391
United States	1,024	10,766	996	14,154
France	129	1,207	303	4,148
Great Britain	120	1,583	125	1,639
Netherlands	30	162	450	10,957
Japan	162	1,295	178	1,687
Others	640	2,245	673	4,061
Total	8,372	132,733	11,972	206,037

Germany has been the principal source of supply of plastic materials, distribution being effected through the Peruvian branch office of the I. G. Farben Industrie. The competition has resulted principally from the fact that German quotations averaged 50 percent less than American prices for plastic preparations. American materials, although not being of the same composition as the German, could have been used in the local industry.

Plastic materials fall under the following Peruvian customs classifications for duty purposes:

Galalith for the manufacture of combs and the like, duty S/1.00 per gross kilogram.

Synthetic materials not specified, duty S/2.00 per legal kilogram.

Celluloid in sheets for cards and other uses, duty S/1.00 per legal kilogram.

There are no special import restrictions nor regulations which would apply to plastics.

Trade promotion—As far as can be determined, the only types of plastic materials being imported are semi-processed. The share of the United States in the limited local plastic trade has been negligible, as German agents offered better prices for plastics for pressure molding and in sheet form.

Generally speaking, with one exception, scientific and technical knowledge of the plastic industry is lacking in Peru and education and pioneer work by factory representatives on the ground could undoubtedly bring about an increased number of consumers and a consequent larger demand for prime materials of this type.

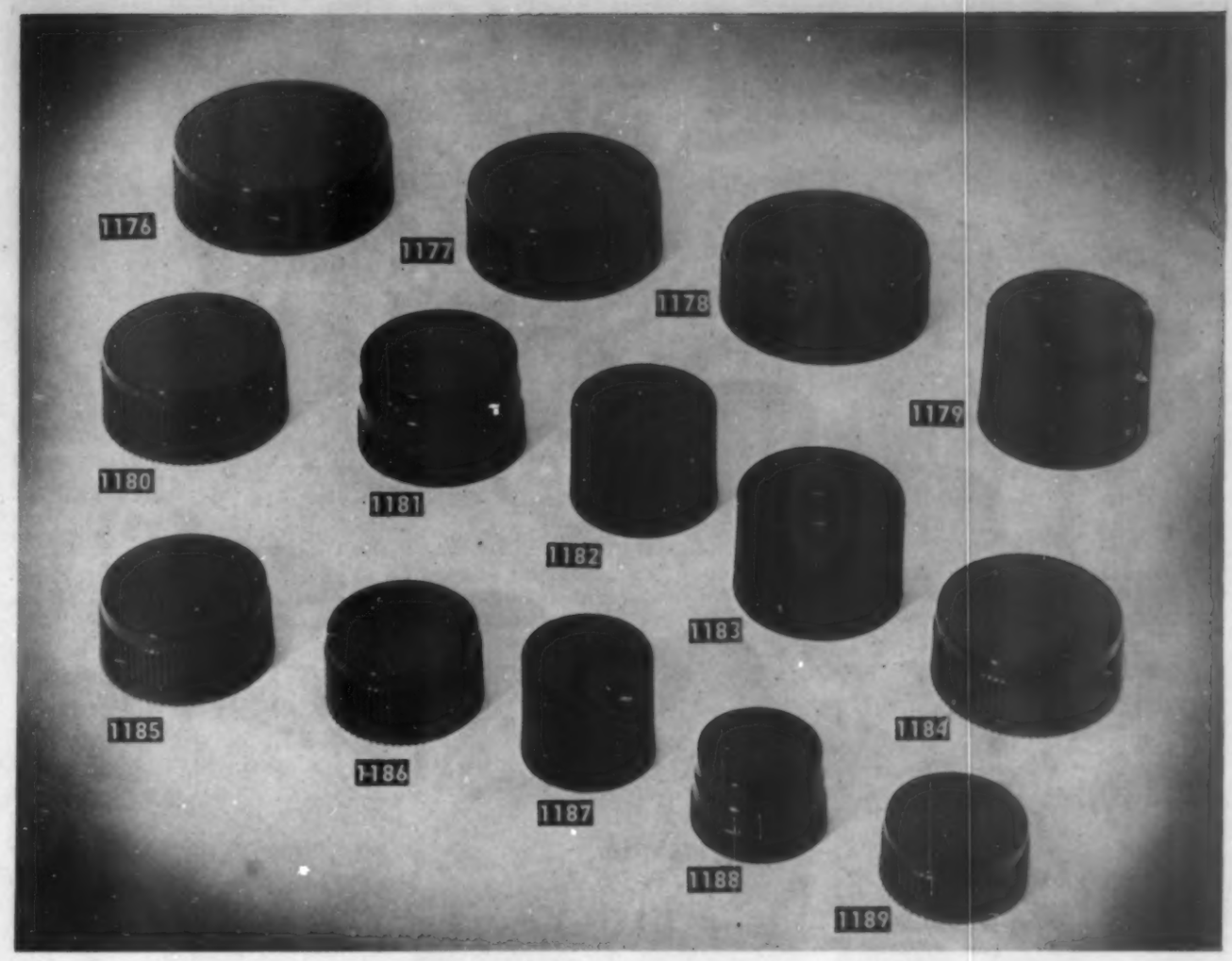
At present, in view of the war in Europe, the few consumers of plastics are turning to the United States as a source of supply. One manufacturer is planning not only to increase his production but is endeavoring to purchase an injection molding machine in the United States.

Sales of plastics should be effected preferably through a factory representative established in Peru, rather than by direct sales.

Stocks and servicemen at this time are not essential because of the limited number of consumers, but samples are important in order to secure the business available.

The Commercial Intelligence Division has on file a list of plastic products manufacturers and agents available for the nominal fee of $1.00 each.

Machinery, plastic-molding machinery and mechanical equipment for the plastic industry—An important manufacturer of plastics in Peru is operating at present a bent lever press (Grabner) of German manufacture, of 45 to (*Please turn to page 100*)



Sheets One to Fifty-Two reprinted in book form, Twenty-five cents in coin or stamps

Stock Molds

SHEET NINETY-SIX

Decorative threaded bottle caps in standard colors are available without mold cost from stock molds. Address Stock Mold Department, Modern Plastics, Chanin Building, New York, for manufacturers' names and addresses

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1176. Short skirt, knurled 33 mm. cap. Diameter 1 7/16 in. 1/2 in. high

1177. Short skirt, knurled 28 mm. cap. Diameter 1/4 in. 1/2 in. high

1178. Short skirt, knurled 30 mm. cap. Diameter 15/16 in. 7/16 in. high

1179. Short skirt, fine knurl 22 mm. cap. Diameter 1 in. 3/4 in. high

1180. Short skirt, knurled 24 mm. cap. Diameter 1 1/8 in. 1/2 in. high

1181. Medium skirt, knurled, 3-step 20 mm. cap. Diameter 15/16 in. 5/8 in high

1182. Medium skirt, fine knurl, 18 mm. cap. Diameter 13/16 in. 5/8 in. overall height

1183. Medium skirt, fine knurl 20 mm. cap. Diameter 15/16 in. 3/8 in. overall height

1184. Short skirt, knurled 22 mm. cap. Diameter 1 in. 7/16 in. high

1185. Short skirt, knurled 20 mm. cap. Diameter 15/16 in. 7/16 in. high

1186. Short skirt, knurled 18 mm. cap. Diameter 13/16 in. 7/16 in. high

1187. Deep skirt, fine knurl 15 mm. cap. Diameter 7/16 in. 5/8 in. high. Available with peg or well

1188. Short skirt, fine knurl, 3-step 15 mm. cap. Diameter 7/16 in. 7/16 in. high. Available with peg or well

1189. Short skirt, knurled 15 mm. cap. Diameter 3/4 in. 3/8 in. high. Available with peg or well

All molders are invited to send samples from their stock molds to appear on this page as space permits

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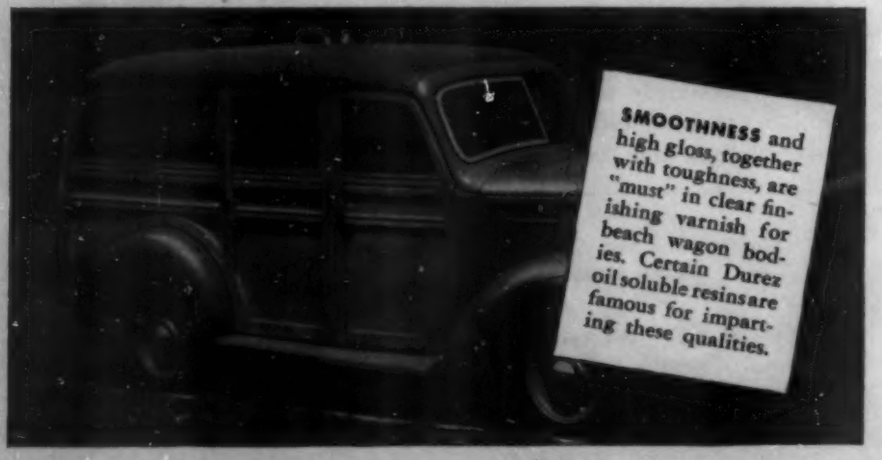
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RESINS THAT FIT THE JOB

Aniline-bagasse plastics

by T. R. McELHINNEY* and S. I. ARONOVSKY**

A PREVIOUS report from this laboratory[4] discussed briefly some of the methods which have been proposed for the production of molding compounds from ligno-cellulosic waste materials. The methods developed at the U. S. Forest Products Laboratory[1,5] were chosen as offering the most ready application to farm waste materials. Due to lack of equipment for making a study of the aniline process[1,6,7], the above report[4] was chiefly confined to a study of the effect of varying conditions in the acid-hydrolysis method.

Following acquisition of proper equipment for continuing these studies, a few preliminary digestions with aniline were made, which indicated, at least for bagasse, that this method of making plastic materials offered much greater opportunities than the acid-hydrolysis method for producing commercially usable products. Strength and flow properties apparently could be varied over wide ranges. The object of this study was to show which of the several factors entering into the production of these plastics was of most importance and, if possible, to find conditions which would result in a molding compound suitable for commercial use. It is self-evident that it would be an impractical undertaking to attempt to establish positively the best possible combination of the seven or eight major factors in the preparation of these plastic compounds; it was hoped that the possible combinations could be narrowed to within reasonable working limits. In order to make the most efficient use of the equipment involved, it was necessary to follow a definite schedule of work carrying out this study. Because of this, certain arbitrary procedures followed were later found to give rather unsatisfactory results.

Experimental

Raw material: The bagasse used in these experiments was from the 1938 crop of Louisiana sugar cane. Prior to use, several bales of the bagasse were broken up by passage through a very coarse shredder. The shredded material was thoroughly mixed and air-dried to approximately 7 percent moisture. Moisture analyses were made daily and all figures reported are based on oven-dry bagasse.

Digestions: Digestions were made in a steam-jacketed, tumbling, bronze autoclave having a capacity of 20 gallons and rotating at approximately four revolutions per minute. Fifteen pounds of bagasse were used for each digestion, with the exception of run 25 in which only 10 lb. could be used with the desired water-to-bagasse ratio. Each of the four principal digestion factors, (*a*) ratio of aniline to bagasse, (*b*) ratio of water to bagasse, (*c*) pressure, and (*d*) time of digestion, were varied individually while holding the other three factors constant at arbitrarily chosen values. The ratio of aniline to bagasse was varied from 0 to 0.35, the digestion pressure was varied from 90 to 190 lb. (the upper pressure limit of the digester) by 20-lb. increments, and time at pressure was varied from 30 to 300 minutes. Study of the effect of the water-to-bagasse ratio was limited to three digestions, using weight ratios of 3.75 : 1, 5.60 : 1, and 7.46 : 1, respectively. Only one digestion was made at each condition, since the additional work involved in duplication was not considered necessary in a preliminary study of this nature.

To make a digestion, the bagasse and the chosen amounts of water and aniline were sealed in the digester, steam turned into the jacket, and rotation started. The contents of the digester were brought up to the desired pressure as quickly as possible, venting the enclosed air and non-condensible gases until the internal temperature corresponded to the selected pressure. The time required to reach this pressure was recorded and the digestion continued for the predetermined period. At the end of the digestion, the digester was blown down as rapidly as possible without loss of fine material. The contents were dumped and filtered on a stoneware

* Present address is Valentine Sugars, Lockport, Louisiana.

** Agricultural By-Products Laboratory, Ames, Iowa. Established by the Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture, in cooperation with the Iowa State College.

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Table I. Preparation and Tests of Aniline-Bagasse Plastics

Run no.	Digestion Conditions: Aniline (% based on bagasse)	Water (% based on bagasse)	Digester pressure	Temperature	Time to reach maximum pressure	Time at maximum pressure	Yield (% based on original bagasse)	Grinding mesh	Plasticizers: Furfural (% based on digested bagasse)	Aniline (% based on digested bagasse)	Phenol (% based on digested bagasse)	Mixing time	Strength Tests: Flexural strength	Impact strength, notched Izod	Impact strength, unnotched Izod	Drop test (see text)	Hardness, Scleroscope	Moisture absorption (air-dry basis)	Moisture absorption (oven-dry basis)	Specific gravity of molded specimen	Bulk factor	Relative molding quality
	%	%	lb./sq. in.	°F.	min.	min.	%	mm.	%	%	%	min.	lb./sq. in.	ft. lb.	ft. lb.	ft.		%	%			
1	21	375	90	331	35	180	93.3	1.00	8	0	0	20	6450	0.194	0.454	36		2.12	2.99	1.34	3.90	U
									8	8	0	20	5350	0.166	0.361	36		1.21	1.76	1.36	4.35	F+
									8	0	8	20	5380	0.153	0.402	36	78	2.28	2.97	1.34	3.36	F+
2	21	375	110	344	38	180	93.7	1.00	8	8	0	20	4670	0.125	0.311	24	81	0.73	1.18	1.34	3.43	E
								1.50	8	8	0	20	4870	0.143	0.284	24	71	0.90	1.10	1.35	3.92	E
								6.35	8	8	0	20	4740	0.128	0.377	6		0.81	1.07	1.33	3.60	E
3	21	375	130	356	50	180	93.7	1.00	8	0	0	20	5100	0.119	0.369	12	72	0.74	1.14	1.35	3.38	F−
									8	8	0	20	4240	0.108	0.263	6		0.69	1.03	1.33	3.59	F+
									8	0	8	20	4795	0.102	0.383	12	83	1.09	1.43	1.33	2.66	E
									8	0	0	20	4780	0.098	0.272	12		1.28	1.43	1.36	3.26	U
4	21	375	150	366	40	180	92.2	1.00	8	8	0	20	3960	0.082	0.245	6	82	0.95	1.05	1.34	3.62	E
									8	0	8	20	3900	0.092	0.334	12	89	1.13	1.25	1.31	2.76	E
5	21	375	170	375	50	180	88.4	1.00	8	8	0	20	3977	0.084	0.218	12	81	0.58	0.98	1.34	3.02	E
								1.50	8	8	0	20	3417	0.092	0.279	6		0.60	0.88	1.33	3.33	E
								6.35	8	8	0	20	3778	0.096	0.220	6	90	0.69	1.12	1.33	3.11	E
5A	21	375	170	375	50	180	89.2	1.00	8	0	0	20	4728	0.084	0.327	6	85	0.87	1.39	1.34	3.60	F+
									8	0	8	20	3833	0.081	0.300	6	82	0.63	1.21	1.31	2.74	E+
									12	0	12	40	3175	0.091	0.198	6	87	1.54	2.30	1.32	2.50	E+[b]
6	21	375	190	384	55	180	88.0	1.00	8	8	0	20	3660	0.105	0.269	6	83	0.54	0.61	1.33	2.93	E
								1.50	8	8	0	20	3296	0.079	0.262	6	83	0.54	0.79	1.33	3.06	E
								6.35	8	8	0	20	3793	0.078	0.209	6		0.58	0.85	1.34	3.02	E
6A	21	375	190	384	55	180	88.0	1.00	8	0	0	20	4443	0.106	0.263	6		0.85	1.00	1.34	3.75	F+
									8	0	8	20	3518	0.082	0.262	12		0.80	1.21	1.34	2.94	E
									12	0	12	40	3990	0.086	0.276	6		1.82	2.17	1.33	2.79	E+
7	21	375	190	384	55	120	93.4	1.00	8	0	0	20	4430	0.085	0.295	12	80	1.06	1.24	1.35	3.65	F
									8	8	0	20	4030	0.090	0.275	6	90	0.76	0.93	1.34	3.54	E−[c]
									8	0	8	20	4090	0.084	0.260	6	81	0.99	1.15	1.35	2.95	E
									8	0	0	20	4930	0.108	0.287	6		1.30	1.48	1.38	3.73	F+
8	21	375	190	384	65	60	91.3	1.00	8	8	0	20	4510	0.107	0.271	6		0.81	0.96	1.36	3.39	E
									8	0	8	20	4175	0.112	0.266	6	86	1.24	1.43	1.35	2.89	E
									8	0	0	20	5280	0.158	0.361	24	81	1.05	1.27	1.36	3.81	F+
9	21	375	190	384	55	30	90.0	1.00	8	8	0	20	4780	0.133	0.250	12		0.76	1.05	1.34	3.40	E
									8	0	8	20	4725	0.117	0.252	24	84	1.22	1.53	1.34	2.94	E[c]
									8	0	0	20	4500	0.091	0.240	6	82	0.50	0.81	1.35	3.65	F−
10	21	375	190	384	55	300	90.0	1.00	8	8	0	20	3800	0.094	0.155	6	87	0.67	0.81	1.33	3.46	F
									8	0	8	20	3923	0.088	0.228	6		0.89	1.06	1.35	2.84	E
									8	8	0	10	4440	0.103	0.306	6		0.76	0.92	1.35	2.96	E
									8	8	0	20	3760	0.085	0.230	6		0.77	0.91	1.34	2.81	E
									8	8	0	30	4930	0.098	0.294	6		0.71	0.86	1.33	2.65	E[d]
11	21	375	150	366	35	180	89.8	1.00	8	8	0	60	4220	0.100	0.255	6		0.67	0.82	1.34	3.21	E
									8	8	0	120	4780	0.075	0.283	6	88	0.50	0.64	1.32	3.43	E
									8	8	0	180	4540	0.074	0.275	6		0.57	0.68	1.33	3.46	E
									8	0	0	20	3890	0.077	0.204	6	89	0.76	0.97	1.28	3.39	E
12	35	375	190	384	56	180	97.0	1.00	8	8	0	20	3330	0.086	0.184	6		0.63	0.73	1.32	2.50	E[e]
									8	0	8	20	3200	0.078	0.170	6	88	0.77	0.89	1.30	2.46	E
									8	0	0	20	4995	0.100	0.301	12		0.57	0.74	1.35	3.51	E
13	24	375	190	384	60	180	94.2	1.00	8	8	0	20	4537	0.110	0.196	6		0.64	0.79	1.34	3.48	E
									8	0	8	20	4462	0.077	0.324	12		0.64	0.74	1.34	2.88	E+
									8	0	0	20	4500	0.086	0.231	6	90	0.95	1.12	1.33	3.18	F[f]
14	18	375	190	384	50	180	87.3	1.00	8	8	0	20	3750	0.077	0.209	6	87	0.65	0.78	1.32	3.02	F+
									8	0	8	20	3920	0.077	0.233	6		0.43	0.85	1.32	2.96	F+
15	15	375	190	384	55	180	83.5	1.00	8	8	0	20	4775	0.083	0.251			1.00	1.40	1.32	3.80	U
									8	8	0	20	3970	0.079	0.216		87	0.62	0.91	1.33	3.06	U
									8	0	8	20	4130	0.094	0.237	6	81	1.16	1.36	1.32	3.17	F
									8	0	0	20	4280	0.104	0.260	6		1.63	1.86	1.35	3.78	U
16	12	375	190	384	55	180	81.5	1.00	8	8	0	20	4600	0.080	0.231	6	85	1.15	1.33	1.35	3.50	U
									8	0	8	20	4493	0.087	0.344	12	82	1.75	2.02	1.34	3.08	F−
									8	0	0	20	...	...	...	...	..	...	...	...	...	[g]
17	9	375	190	384	65	180	78.4	1.00	8	8	0	20	3977	0.081	0.262	6		0.89	1.38	1.34	3.62	U+
									8	0	8	20	3810	0.086	0.288	6		2.31	2.81	1.34	3.15	F−
									8	0	0	20										[h]
18	5	375	190	384	60	180	75.2	1.00	8	8	0	20										[h]
									8	0	8	20										[h]
									8	0	0	20										[h]
19	0	375	190	384	60	180	67.8	1.00	8	8	0	20										[h]
									8	0	8	20										[h]
	A								6.35	8	0	8	20	4970	0.175	0.462	12	83	1.59	2.07	1.36	2.99	E
	B1								1.00	8	0	8	20	5900	0.190	0.448	36	85	1.96	2.50	1.35	3.23	E[i]
20	B2	21	375	190	384	60	30	91.0	1.00	8	0	8	20	4675	0.116	0.372	12		1.32	2.03	1.33	3.06	E[j]
	C1								1.00	8	0	8	20	6250	0.254	0.415	24	81	2.27	2.67	1.36	4.35	F+[k]
	C2								1.00	8	0	8	20	4490	0.127	0.618	24	78	1.75	2.18	1.35	2.96	E+[l]
										8	0	0	20	5172	0.125	0.272	12		0.96	1.07	1.33	3.33	U
21	21	375	190	384	60	180	89.0	[q]		8	8	0	20	4142	0.116	0.263	12		0.90	0.98	1.33	3.66	E[m]
										8	0	8	20	4413	0.112	0.235	12		0.72	0.91	1.34	3.08	E
										8	0	0	20	5595	0.183	0.312	24		0.86	0.98	1.36	3.60	U
22	21	375	130	356	40	180	93.0	[q]		8	8	0	20	4898	0.166	0.241	36		0.73	0.89	1.35	4.18	E[m]
										8	0	8	20	5195	0.181	0.323	24		0.99	1.12	1.34	3.29	E
										8	0	0	20	5847	0.122	0.362	24		0.69	0.87	1.35	3.92	F
23	21	560	190	384	60	180	85.0	1.00	8	8	0	20	5207	0.136	0.280	12		0.65	0.79	1.35	4.73	E[n]
									8	0	8	20	4340	0.116	0.395	12		0.82	0.97	1.34	3.35	E[n]
									8	0	0	20	5772	0.155	0.344	24		0.89	0.99	1.37	4.53	U
24	21	746	190	384	55	180	86.5	1.00	8	8	0	20	6107	0.155	0.267	24		0.84	0.99	1.34	5.23	E
									8	0	8	20	5367	0.169	0.398	24		0.96	1.26	1.34	3.62	E
25	21	1000	110	344	55	180	89.2	[q]	8	0	8	30	6900	0.243	0.483	36		1.36	1.62	1.34	4.83	F+[o]
18:6A	125 g. of 18 mixed with 25 g. of 6A							1.00	8	0	8	20	4920	0.100	0.300	12	87	2.20	2.58	1.34	3.47	F[p]
	100 g. of 18 mixed with 50 g. of 6A							1.00	8	0	8	20	4620	0.086	0.319	12	86	2.32	2.75	1.34	3.22	F+[p]

[a] U = unsatisfactory, F = fair, E = good to excellent.
[b] Stuck to pebbles at end of 20 min. mix. Came free after 40 min.
[c] Stuck to mold slightly.
[d] This is a combination of two runs which were ground and thoroughly mixed before plasticizing.
[e] Large quantities of gas formed during molding of these powders. Some trouble with sticking.
[f] Seems to mold especially well in flat shapes.
[g] This powder could not be molded. Not tested.
[h] These powders could not be molded. No tests.
[i] Coarse material, screened out and ground. See text.
[j] Fine material, screened out and ground. See text.
[k] Coarse material, screened out and ground after mixing.
[l] Fine material, screened out and ground after mixing.
[m] This material was mixed with plasticizers in the pebble mill and subsequently ground to pass a 1 mm. screen.
[n] Molded pieces have exceptional luster.
[o] This powder prepared after all other powders had been tested.
[p] Compare with 6A for filler effect.
[q] Mixed before grinding to 1 mm.

U. S. D. A. PHOTOGRAPH BY KILLIAN

Dr. S. I. Aronovsky, head of the Agricultural By-Products Laboratory holds a beaker of plastic molding powder derived from agricultural waste materials such as the sugarcane bagasse, straw and corncobs shown on the table. In the foreground are the finished plastic articles

vacuum filter, washed thoroughly with hot water (using a total of 25 gallons of water in five or six washes), and dried at 220 deg. F. The dried material was ground and plasticized.[1a]

Grinding: Grinding of the digested material, either before or after plasticizing, was done in a chopping mill, wherein the fibers are cut by knives to lengths permitting them to pass through a screen of the desired mesh. Commercial firms experimenting with these bagasse plastics have raised the question of the effect of fine grinding of these powders on the strength of articles molded from them. To determine the effect of this fineness, digested material obtained from cooks made at various pressures was divided into three parts and the parts ground to pass 1-mm., 1.5-mm., and 6.35-mm. screens, respectively. The resulting powders were all plasticized in the same manner. The data are shown in runs 2, 5, and 6 in Table I.

Plasticizers: Sherrard, et al.,[7] in their description of this method specify the use of furfural (approximately 7 percent, basis digested material), or of other lignin plasticizers. While preliminary work in this laboratory has shown that 7 to 8 percent of furfural will promote a fair degree of flow under certain conditions of digestion, it was also found that equal amounts of aniline or phenol in addition to the furfural would greatly increase the flow. Other observations were that phenol gave a somewhat longer flow period than aniline, while the aniline-furfural combination gave somewhat better water resistance to the finished articles. Therefore, many of the digested products were divided into three portions which were mixed, respectively, with 8 percent furfural, 8 percent aniline plus 8 percent furfural, and 8 percent phenol plus 8 percent furfural. In two instances, where it was thought advisable to duplicate digestions, because of the division of a digested material into different degrees of fineness (Table I), there would have been a duplication of the aniline-furfural mix. In these two cases, the aniline-furfural mix was omitted and a 12 percent phenol—12 percent furfural mix substituted (runs 5A and 6A). All powders were mixed with 1 percent zinc stearate for mold lubrication.

It should be noted here that, although in the acid-hydrolysis method addition of much more than 8 percent furfural and 8 percent aniline caused surface-checking in finished pieces or a flow of liquid out of the mold,[4] the digested materials prepared by the aniline method seem to be more chemically active and will combine with larger quantities of plasticizers. The acid-hydrolysis method apparently only concentrates the lignin, whereas in the aniline method some portion of the plant material seems to be rendered more active, probably by combination with the aniline, as may be inferred from the increased yields at higher concentrations of aniline in the digestion (runs 6, 6A, and 12 to 19, Table I).

Ballmilling: Although this method of mixing the plasticizers with the digested material is not necessarily the best, a more suitable apparatus was not available. It was thought that some study of this method of mixing might offer a suggestion for a better method. The machine used was a ceramic-lined pebble mill 24 in. in diameter and 30 in. long, rotating at 38 revolutions per min., and containing 130 lb. of assorted flint pebbles. Four pounds of powder were mixed in each batch. One run (Table I, run 11) was made to study the effect of time of milling, which was varied from 10 to 180 minutes. Powders from all other runs, except 25 and the special phenol-furfural mixes in 5A and 6A, were mixed 20 minutes, as shown in Table I.

Molding: Molding conditions were chosen arbitrarily. Since these powders are slow-curing under the conditions used, they are essentially thermoplastic and, therefore, molding conditions are relatively unimportant, except that temperature and pressure must be high enough to obtain complete flow. Flexural and impact test pieces were molded in a single-cavity hand mold which produced bars $^1/_2$ in. by $^1/_2$ in. by 5 in. long. The mold was constructed with interchangeable bottom force plates to make both straight bars for flexural and unnotched impact test pieces and a notched impact test piece with a notch of dimensions as specified by A. S. T. M. Committee D-9[2]. The mold was loaded at approximately 200 deg. F., placed in the press, and the required pressure applied and held until the temperature reached 320 deg. F. (*Please turn to page 88*)

[1a] Forms of the word *plasticized* are used throughout this paper for want of better ones. Actually, there is probably at least a partial condensation between the aniline and lignin present in the digested material and the *plasticizing* chemicals. However, since these chemicals do add the quality of flow to the digested material, *plasticization* is probably a more suitable term than *condensation* or *resinification*.

To withstand varying conditions for repeated trips to southern waters, Panama R. R. Steamship Line vessels are coated with Bakelite resin base paints. The S. S. "Cristobal" funnel is coated with Toch Bros.'s buff, and battleship gray, aluminum, green and black are used for the hull, superstructure and boot topping

Synthetic resins in corrosion-resistant paints**

by ROBERT J. MOORE*

IRON, steel, and the non-ferrous alloys, such as Duralumin and magnesium alloy, are in unstable equilibrium and tend to revert back to the natural oxides from which they were formed. Twenty-four million tons of steel a year, it is estimated, are lost due to preventable corrosion. This staggering figure is further multiplied by the resulting weakening of structures and equipment due to metal failure. The petroleum industry alone estimates its annual corrosion loss at 125 millions of dollars in refineries and 50 millions in pipe lines. The serious nature of the corrosion problem may be realized by a review of the industrial magazines covering only a few of our industries: marine, automotive, aircraft, railway, public utilities, refrigeration, and manufacturing. Article after article appears in these journals showing the tremendous losses suffered and the efforts to bolster the defense. This defense lies in protective coatings for metal surfaces. This paper is concerned with the modern developments in such protection, based on synthetic resins.

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** Based on a paper presented at a meeting on *New Developments in Protective Coatings for Industry*, at The Franklin Institute, January 30, 1940.

Transformation in coatings

Modern research and synthetic chemistry have revolutionized many of our industries during the past two decades. The paint and varnish industry is a notable example of such a change, for during the past fifteen years its raw materials, its finished products, and its methods have undergone basic changes.

As late as 10 to 15 years ago the raw materials of the varnish industry were substantially the same as they had been since antiquity. The drying oil, such as linseed oil pressed from flaxseed, or tung oil from Chinese trees; the natural resins, such as the fossil Copals from Africa and New Zealand; the driers, such as salts of lead, cobalt, and manganese; and finally the thinners, such as turpentine, all these ingredients had been used for centuries. The early Egyptians used flaxseed oil and fossil resins in their coatings. Both Pliny and

Discorides in ancient times describe drying oils and resins dissolved in them. Galen in the second century A.D. mentions the use of lead and umber as driers. These were still the main raw materials used in paint and varnish of the early 1920's.

Then came the demand for greater speed in finishing and better durability and protection. The auto industry could no longer keep a car in the finishing shop for twenty-one days; and the durability of the easily marred and rain-spotted carriage finish was not good enough. Nitrocellulose lacquers appeared, bringing new speed and a challenge to the varnish industry. The varnish industry turned to chemical research and new raw materials to meet the competition and to bring new speed and resistance to protective coatings.

Their first change was to speedier varnishes using phenol-formaldehyde resin dispersed in rosin or its compounds. Tough, hard, durable, waterproof, resistant to solvents, acids, and alkalies, and a high dielectric and insulating material, phenol-formaldehyde resin filled the waiting need in many industries. Its insolubility in drying oils, however, required the dispersion of the phenolic resin in other resins for use in the first four-hour varnishes. Then in 1928 phenolic varnish resins, 100 percent phenol-formaldehyde and compatible with drying oils, were made available to form the new polymerized paint and varnish products of today.

About this same time there also appeared as raw materials alkyd resins from phthalic anhydride, vinyl resins, resins from urea, from petroleum and other sources. New chemical pigments, drying oils, driers, wetting agents, cellulose and rubber derivatives, and solvents gave the paint and varnish chemists a wide latitude on which to base a new series of really protective coatings. It is these new coatings, based on synthetic resins, that have in the past ten years shown much greater protection as paints for metal than the former paints based on linseed oil.

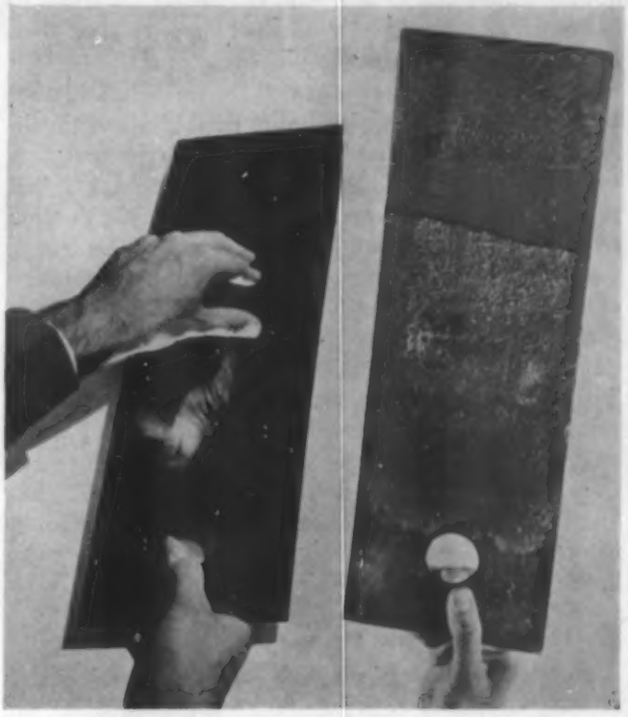
Properties of phenolic resin coatings

Phenol-formaldehyde resins are used by the paint and varnish manufacturer to produce the following new properties in his paint films:

Greater speed: The drying time of exterior coatings is reduced from 24 and 48 hours to 4 or 5 hours. Where still greater speed is required, anticorrosive primers may be made to air-dry in one minute.

Durability: In the past the varnish maker depended upon the use of larger proportions of drying oils to increase durability. His higher resin content coatings while harder were poorer in durability. The new phenolic resin, however, reversed this, so that increasing the resin content produced improved hardness and at the same time increased retention of toughness on exposure and resistance to light, air, and water. Varnished panels exposed to atmospheric conditions in Florida show a marked increase in durability between the spar varnishes obtainable in 1928 and the phenolic type of a few years later. In three months' exposure at 45 deg. facing the sun the old-fashioned varnishes based on fossil resins or rosin and ester gum are badly deteriorated. After six months, however, the varnishes made with phenol-formaldehyde resin have not even lost their gloss.

Water resistance: Perhaps the most important property of a protective coating is its ability to resist moisture. If it is to protect lumber, then it must resist the absorption of moisture on a wet day causing swelling, and the subsequent shrinkage on a dry day. This repeated expansion and contraction causes the weathering and breakdown in the wood. If we are to protect metals, then moisture resistance is paramount. Through the use of the phenolic resin in paints and varnishes we have achieved a degree of resistance to water impossible ten years ago. For example, the tests of the Forest Products Laboratory[1] showed that the average moisture absorption through 8 non-phenolic spar varnishes is over twenty times greater than through phenolic resin varnish. J. L. McCloud, metallurgical chemist of the Ford Motor Co., wrote that "By the proper choice of resin, oil, and drier, a very moisture-resistant coating may be obtained," and that phenolic resin "spar varnishes are the outstanding present-day examples of this in the air-dry field."[2]



Test panels, coated on one side with Hastolite phenolic resin heat-reactive coating and on the other with different systems and then alternately subjected for one week to gasoline, hot salt sea water and moist air, week after week, appeared like this one above at the conclusion of two years. Only the resin-surfaced side (left) withstood these severe conditions

[1] Effectiveness of Moisture-Excluding Coatings on Wood, by George M. Hunt, U. S. Department of Agriculture, Circ. No. 128, Oct. 1930.
[2] A.S.T.M. Symposium on Protecting Metals Against Corrosion, p. 22, April 1938.

(*Please turn to next page*)

Chemical resistance: In addition to the aforementioned properties of speed, durability, and water resistance, the chemical resistance of the phenolic-resin-fortified coating is outstanding. This stability involves resistance to soaps and alkalies, dilute acids and salts, oxidation, and disintegration by air, sunlight, and industrial fumes. The chemical resistance of these coatings frequently is demonstrated by immersing the films in a 5 percent solution of caustic soda. In this test rosin derivatives, fossil resins, and some synthetic resins are dissolved. The phenol-formaldehyde resin, however, enables the film to meet the modern specifications for spar varnishes or vehicles for primers, aluminum enamels, and other protective paints, requiring immersion in 5 percent caustic for 8, 24, and 48 hours. The methods for conducting resistance tests and others are described in the literature.[3]

Flexibility and its retention: The life of a resistant film is indicated by a high initial flexibility and toughness coupled with the *retention* of this property on exposure. The phenolic varnishes have high initial flexibility. This may be indicated by a kauri reduction requirement of over 140 percent for a 33-gallon length varnish. But more important to us is the retention of flexibility or life on aging. Since these new varnishes and vehicles are highly polymerized, they do not require the high oxidation as of old to form solid films. They are more nearly inert, polymerized films. Their freedom from peroxides, hydroxy acids, and other unstable compounds, present in the older fossil or rosin films, gives retention of flexible life on exposure. Thus kauri reduction tests before and after exposure or bending tests over mandrils before and after baking show high flexibility.

Rusting of iron and steel

Dry iron will not rust, nor will dry aluminum or magnesium alloys corrode. The vehicle used for our paints, therefore, must be as water-resistant as possible in order to keep moisture on the metal surface to a minimum. However, since no organic film is 100 percent waterproof and since there may be moisture present on the metal surface or during the drying, let us examine the reaction of rust formation.

The initial step in rusting is brought about by the solution potential of the metal in water, thus iron gives ferrous ion plus 2 electrons.

$$Fe^0 \rightarrow Fe^{++} + 2^{(-)}$$

Water is present in equilibrium with its ions hydrogen and hydroxyl.

$$\underset{\text{(Neutral)}}{H_2O} \rightleftarrows \underset{\text{(Acid ion)}}{H^+} + \underset{\text{(alkali ion)}}{OH^-}$$

Now the potential of the electron from the metal is sufficient to displace the hydrogen ion from water as dissolved or gaseous hydrogen leaving the hydroxyl ion (OH^-) in excess to give an alkaline reaction.

$$\underset{\text{Hydrogen ion}}{2H^+} + \underset{\text{Electrons}}{2^{(-)}} \rightarrow \underset{\text{Hydrogen gas}}{H_2}$$

This reaction may be followed visually by placing a piece of iron in the so-called ferroxyl reagent containing some ferricyanide ion to turn deep blue with the ferrous ion (Fe^{++}) and some phenolphthalein indicator to turn deep pink with the alkaline hydroxyl ion (OH^-). The solution is caused to gel with a little agar-agar. After 24 hours distinct areas will appear on the metal showing deep blue where iron has gone into solution and reacted to form ferrous ferricyanide. Other areas will show the resulting alkali set free and giving the deep pink coloration.

The chemistry of the rusting reaction shows that a good anti-corrosive primer must have resistance to moisture and to dilute alkalies. In the past, metal protective paints were based on pigment in linseed oil, which has particularly poor water-resistant properties and which moreover is readily softened and attacked by dilute alkalies.

Inhibitors in anti-corrosive paints: If in the ferroxyl test previously mentioned we add to the reagent a few drops of a soluble chromate, such as the potassium or sodium salt, the chromate ion ($CrO_4^{=}$) acts to inhibit the solution potential and no color appears. The iron does not go into solution as shown by the absence of the ferrous blue and there is no alkali to turn the indicator pink. We call the chromate ion an *inhibitor* of the rusting reaction. The soluble chromates mentioned above are too easily dispersed in water to be used in paints but we can use a chromate pigment called zinc yellow (zinc chromate) which has just enough solubility to give a trace of the chromate ion and thus act as an inhibitor. If we stir in a little zinc chromate with the ferroxyl reagent before it gels, the piece of iron does not corrode and no alkali is set free. However, insoluble chromates, such as chrome yellow (lead chromate) and American vermilion (basic lead chromate), do not inhibit the reaction and the blue and pink areas of corrosion appear. Likewise, in similar tests other typical pigments, such as red lead, blue lead, iron oxides, have no inhibiting effect. If these are used in primers, they should be augmented with satisfactory quantities of the zinc chromate. Tests on anti-corrosive primers during recent years have been most favorable to those embracing in their formulation besides intrinsic durability these factors of *moisture resistance*, *alkali resistance*, and *chromate inhibitor*. Tide level tests made on steel panels demonstrate the remarkable protective qualities of such primers compared with the so-called anti-corrosive paints of a short seven years ago.

Specifications for phenol resins

Engineers and others in charge of maintenance have cooperated with the paint and varnish industry in the testing and specifying of these modern primers and resistant finishing paints. In some cases it has been found advisable for the (*Please turn to page 96*)

[3] Moore & Turkington Specification Methods for Evaluating Phenolic Resin Varnishes, Paint, Oil & Chemical Rev., June 13, 1935. (Copies available.)

Permanence of the physical properties of plastics*

by J. DELMONTE

Plastic materials are subject to certain changes in physical properties during their various applications. Particularly significant are the creep and cold-flow phenomena. In Part 1 of this paper published in our May 1940 issue, a general equation is developed expressing plastic-deformation rate as a function of a coefficient of viscous resistance and of a coefficient of internal resistance. In this concluding part, plastic deformation data for laminated phenolics, polyvinyl chloride acetate, methyl methacrylate, polystyrene, and cellulose acetate are compared. Experimental evidence is presented to show that after a sufficient length of time plastic deformation assumes a constant rate, continuing indefinitely. The dual nature of the molecular structure of plastics is emphasized, in which true elastic deformation may occur, as well as a time-dependent plastic deformation, even at very low stresses. Further data are presented on the shrinkage of various plastics after exposure to elevated temperatures, and the swelling of these materials after exposure to high humidity or water immersion. Loss in impact strength upon exposure to high temperatures is also disclosed for laminated phenolics.

IN PREPARING the data presented in the accompanying set of curves the following procedure was maintained in every case: Due to rapid changes in deformation, following application of the fixed weights serving as the load, a full 60 sec. were allowed to elapse before the first reading was taken. This value was assumed to be y_e (true elastic deformation). Likewise, very rapid changes in deflection occurred upon removal of load, and again 60 sec. were allowed to elapse before the first reading in the recovery curve was taken and r_e (true elastic recovery) measured. Another assumption is the designation of maximum fiber stress above each curve during the loading period, which is correct only for the true initial elastic deformation. This value of maximum fiber stress was obtained from Equations [1] and [2], and naturally will change during time. However, it serves as a comparative indication of how the loads were selected for the materials. The value will be even less significant when the true elastic structure is deformed, which is the case for example, with cellulose acetate at 3000 lbs. per sq. in. maximum fiber stress. Actually, because the effective beam length is quite appreciably shortened by the considerable deflection of the cellulose acetate specimen, the recovery from maximum fiber stress in this one case is so great that there is a smaller separation of deflection ordinates between 2000 and 3000 lbs. per sq. in. than between 1000 and 2000 lbs. per sq. in. (Fig. 6).

All values of deflection in the curves are measured at the end of a 5-in. simple cantilever beam which was adopted as a standard for comparison. It is not possible, either, to compare curves of materials with different thicknesses, unless data are presented as percent of the original deflection. Results are plotted as the "increase in deflection" for various time durations of loads. The increase in deflection over the initial elastic deformation is in fact the plastic deformation Y_p. The elastic deformation was not plotted on the

Fig. 6—Time-deformation curve for cellulose acetate; 50 hours

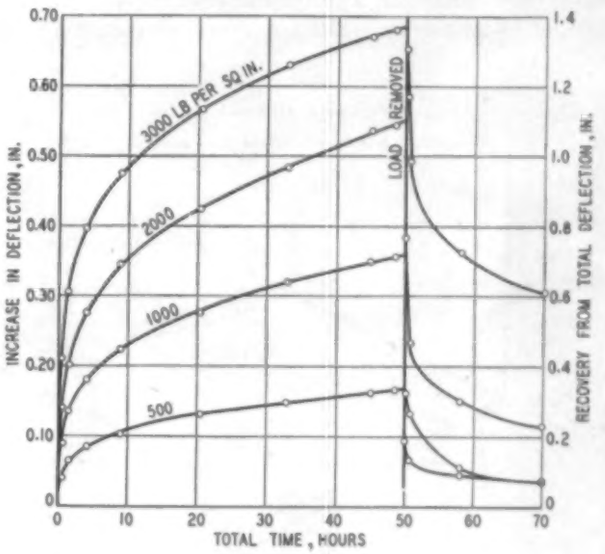


Fig. 7—Time-deformation curve for cellulose acetate, 90 minutes

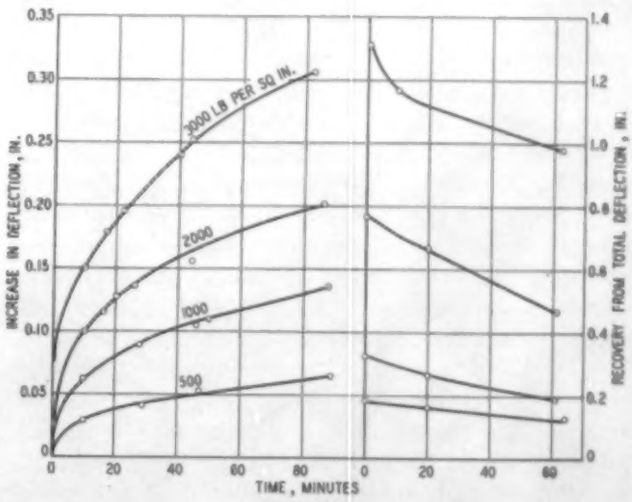


TABLE 1. COLD-FLOW AND CREEP CHARACTERISTICS OF VARIOUS PLASTICS[a]

Material	At maximum fiber stress of 1000 lbs. per sq. in.: Total initial elastic deformation (y_e), in.	Total plastic deformation (y_p) At 1 hr.: In.	Percent y_e	At 100 hrs.: In.	Percent y_e	Coefficient of resistance to cold flow (R)[b]
Polyvinyl chloride acetate	0.407	0.020	4.9	0.106	26.0	1.66×10^6
Polystyrene	0.370	0.012	3.2	0.090	24.0	2.5×10^6
Cellulose acetate	0.727	0.117	16.1	0.480	66.0	0.5×10^6
Laminated phenolic (fabric base)	0.166	0.012	7.2	0.036	22.0	9.08×10^6
Methyl methacrylate	0.446	0.030	6.7	0.065	14.6	4.54×10^6

[a]Data obtained for 5-in. length simple cantilever-beam deflections, corrected for thickness of 0.090 in.
[b]R obtained from slope of curves in Fig. 17.

curves, inasmuch as it was desired to compare the plastic-deformation properties primarily, though the value may be estimated from Equations [1] and [2] readily. They are also given in Table 1. Further, upon the attainment of various time intervals, 50 or 100 hrs., the load was removed and 60 sec. allowed to elapse before the first reading in the recovery curve was taken. This reading would, of course, be a measure of true elastic recovery r_e, and further measurements denoted as recovery from total deflection are in fact plastic recovery r_p. To facilitate measurements upon the slopes of the curves at the initial deflection and initial recovery periods, the same data are plotted for shorter time intervals. For further analysis, a typical stress-deflection-log time curve in three dimensions is plotted for laminated phenolics and methyl methacrylate, Figs. 8 and 9. Both of these curves were plotted according to the same ordinates. The smaller the volume, the more desirable the cold-flow and creep characteristic. The other materials give similar plots, only occupying greater volumes for the same ordinates. All of these data are for a given temperature of 85 deg. F. Figs. 10 to 16 (Pages 66-68) are the deflections in bending, for certain time durations of various stresses for the various materials.

For every material the two stages of plastic deforma-

Fig. 8—Strain-stress-log-time curve for laminated phenolics

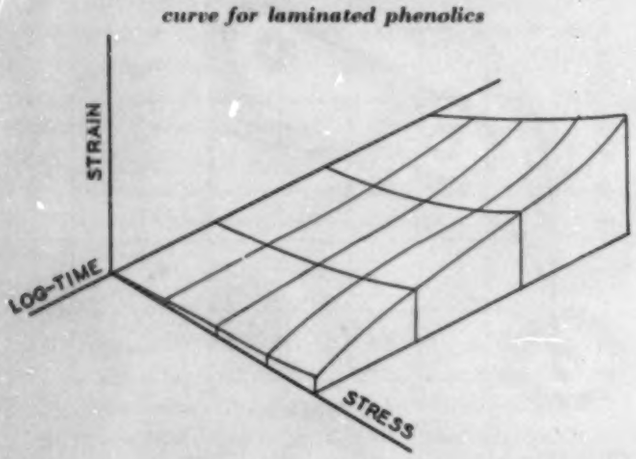


Fig. 9—Strain-stress-log-time curve for methyl methacrylate

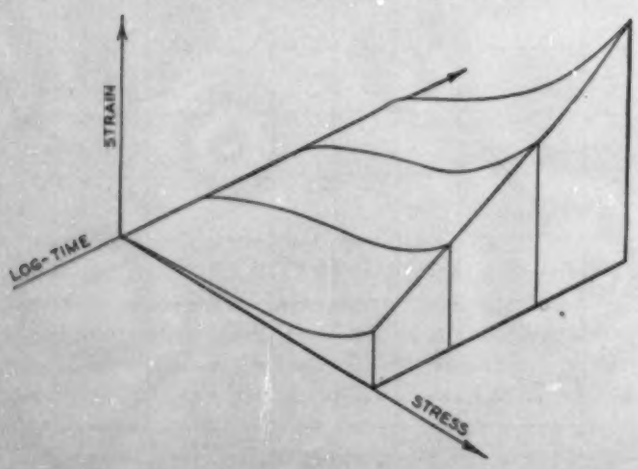
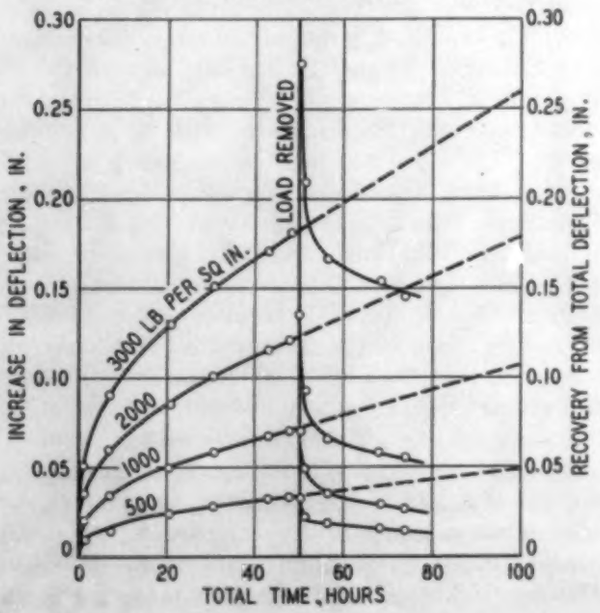


Fig. 10—Time-deformation curve for polyvinyl chloride acetate; 50 hours



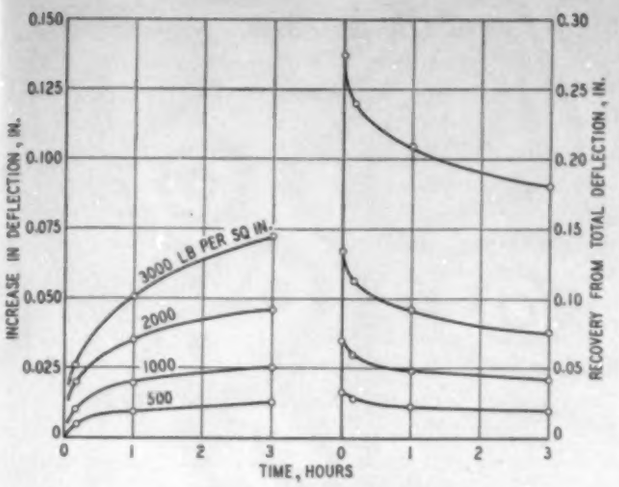


Fig. 11—Time-deformation curve for polyvinyl chloride acetate; 3 hours

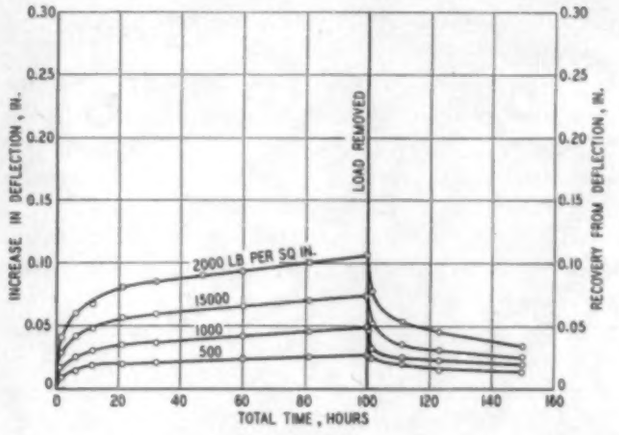


Fig. 12—Time-deformation curve for laminated phenolic plastic; 100 hours

(Thickness 0.065 in.; fine weave fabric base; temperature 85 deg. F.)

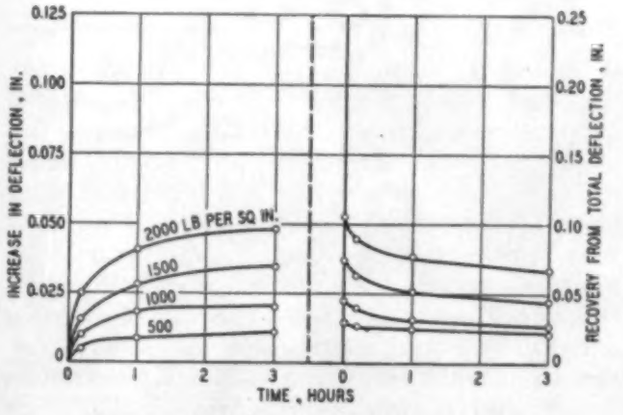


Fig. 13—Time-deformation curve for laminated phenolic plastic; 3 hours

(Thickness, 0.065 in.; fine-weave fabric base; temperature 85 deg. F.)

tion are quite noticeable, more so in some instances than others, namely, where dy/dt is changing (creep) and where dy/dt becomes constant (cold flow). For higher values of stress, the longer is the time required to attain cold flow. The time required to attain cold

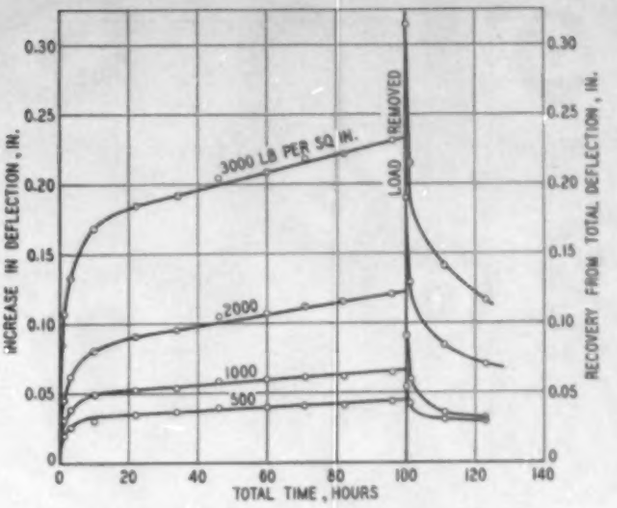


Fig. 14—Time-deformation curve for methyl methacrylate; 100 hours

(Thickness, 0.094 in.; temperature 85 deg. F.)

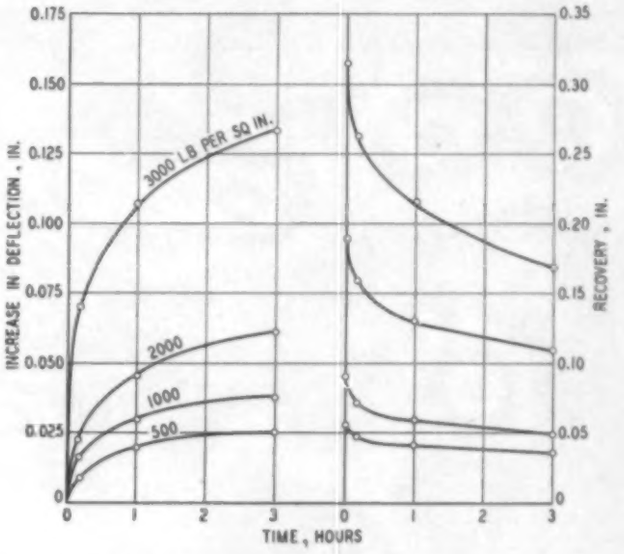


Fig. 15—Time-deformation curve for methyl methacrylate; 3 hours

(Thickness, 0.094 in.; temperature 85 deg. F.)

flow differs considerably in the various materials. For example, methyl methacrylate attains cold flow at a much earlier period than polyvinyl chloride acetate. The fact that the cold-flow rates of methyl methacrylate are considerably smaller than polyvinyl chloride acetate would indicate that the former is to be preferred for applications involving the imposition of stress over long periods of time. On the other hand, the smaller initial deflections of polyvinyl chloride acetate occurring during the early stages of plastic deformation, would mark this material as better suited to short-time applications of stress as compared with methyl methacrylate.

The attainment of constant dy/dt may be shown in Equation [8] after long periods of time have elapsed. This condition was observed for all of the materials under test, and is highly significant, for it means that

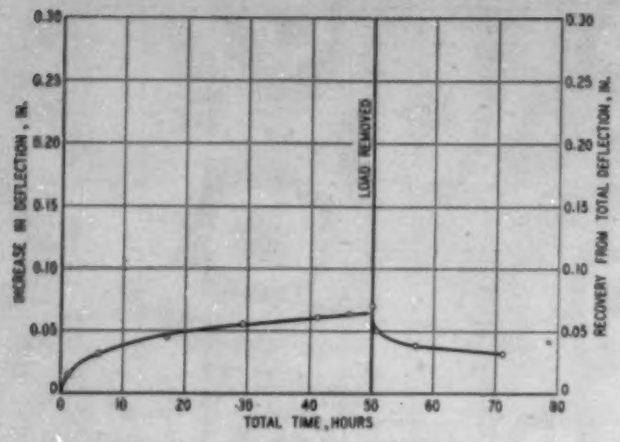


Fig. 16—Time-deformation curve for polystyrene; 50 hours

(Thickness, 0.068 in.; deflections corrected to 5-in. length; temperature 85 deg. F; maximum stress 1000 lb. per sq. in.)

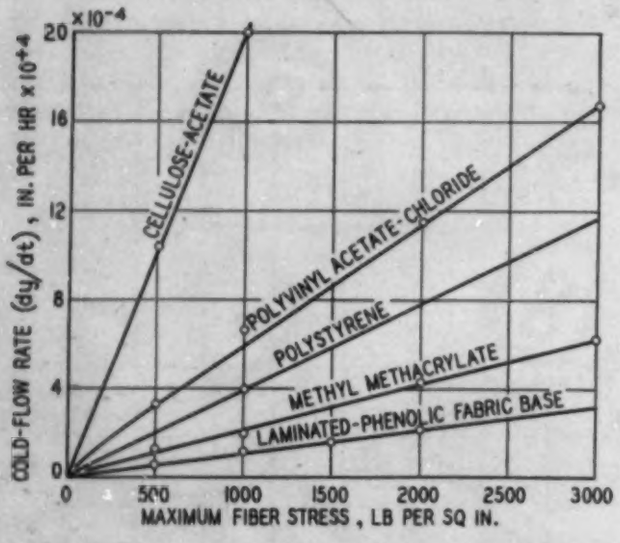


Fig. 17—Cold-flow rate as function of maximum fiber stress

(Cold-flow constant dy/dt for given maximum fiber stress, corrected by 0.09-in. thickness, length 5-in., slope of cold flow characteristics when dy/dt becomes constant at maximum fiber stress)

the cold-flow rate is a straight-line function of the stress. The slopes of the time-deflection curves were measured after cold flow commenced, and plotted as a function of the stress to give Fig. 17. Agreement with theory was observed in every case. We may also deduce from Fig. 17 that cold flow occurs even at very low stresses, as the line has its inception at the origin.

In connection with the tests upon methyl methacrylate, it is also interesting to note the results of other creep tests conducted upon the same type of material, which agree with the results of this test.[29] These specimens were loaded for 20 min. and unloaded for the same length of time, obtaining the time-deformation characteristics. The investigators suggested the following formula for the deformation:

$$y = Ae^{-at} + B \log_e (1 + t)$$

where A and B are functions of the load.

As a basis of comparing the creep and cold-flow characteristics of the materials, Table 1 has been prepared from the data shown in the accompanying curves. For data upon casein plastics, there has been a recent survey of the elastic properties of 60 types of rennet casein.[30] In Table 1, low ratio of plastic deformation to elastic deformation may be deemed desirable, as well as high values of the resistance coefficient R.

Effect of Structure. While insufficient types of the same materials were tested to permit a comprehensive analysis of the effect of molecular structure upon cold-flow characteristics, a few results may be reported. For example, when laminated phenolics were baked at 275 deg. F. for 24 hrs. and then tested under cold flow, a marked decrease was observed, indicating of course that further polymerization had removed from the molecular structure some of those elements susceptible to plastic deformation. Tests upon hot-molded phenolics, which were prepared from more reactive phenolic constituents than employed in the preparation of the laminated materials, exhibited less creep and cold flow than the laminated, and much less permanent set.

As for the effect of orientation of long chain-like molecules present in polystyrene, for example, a few tests conducted to date indicate less cold flow with the unoriented molecules. Another theory has also been advanced that the shorter the chain length, the less the internal frictional resistance to cold flow.[24]

While cold-flow and creep phenomena throw much light upon the relative merits of the commercially available materials, the full answer will not be realized until the effect of molecular weight, molecular orientation, and the effects of extraneous materials such as fillers and plasticizers are fully examined under the same conditions. It is also interesting to note that plastic flow will occur in metals, even at ordinary temperatures at stresses below their elastic limit,[31] though the ratio of plastic deformation to elastic deformation is very much smaller than with the plastics.

Shrinkage of molded plastics at high temperatures

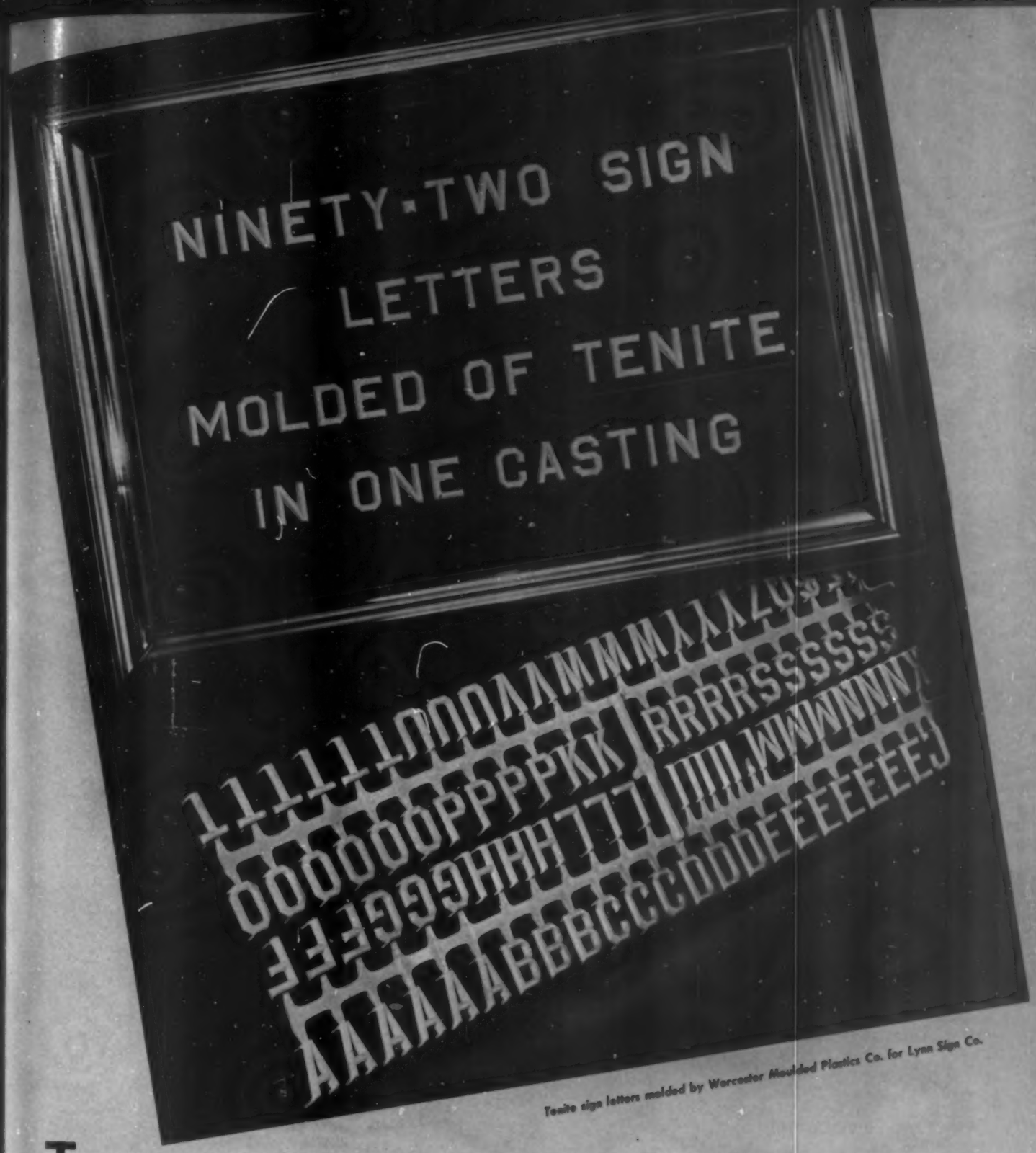
Always a factor in determining the permanency of the physical properties of the plastics is the effect of temperature upon the shrinkage of the materials. This aftershrinkage occurs in addition to the normal thermal shrinkage of the material when it is removed from the mold. Failure to take it into consideration has sometimes caused serious discrepancies in design values. A few results are reported in the curves, Figs. 18 and 19, (Page 84) for various plastics. These are of particular interest to the thermosetting urea and phenolic plastics which are often exposed to higher temperatures than the thermoplastic materials, which are limited by their low heat-distortion point.

It has been generally assumed that further thermal polymerization (with certain temperature ranges) of thermoplastic and thermo- (*Please turn to page 84*)

29. Sub-Permanent Deformation, by J. Galibourg and P. Laurent, Comptes Rendus, *205*, July 19, 1937, pp. 217–219, and vol. *207*, July 4, 1938, pp. 34–35.

30. Elastic and Plastic Properties of Rennet Casein, by C. A. Cooper and P. G. T. Hand, British Plastics, *10*, March, 1939, pp. 572–577.

31. An Apparatus for Determining the Commencement of Permanent Set in Material Used for Flat Springs, by E. V. Walker and K. L. Beak, Journal of Scientific Instruments, *13*, March, 1936, p. 96.



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This digest includes each month the more important articles (wherever published) which are of interest to those who make plastic materials or use them. Requests for copies of the magazines mentioned should be directed to the individual publishers whose addresses will be mailed upon receipt of a self-addressed stamped envelope.

General

PLASTICS AND COAL. N. J. L. Megson and K. W. Pepper. Chem. and Ind. *59*, 247–53 (Apr. 13, 1940). The sources, production, fabrication, and properties of plastics derived from coal are discussed. The theory of Armstrong that "coal for the most part is but a natural bakelite" and that the constitution of coal is, in essence, similar to that of a hardened phenolic resin, is considered in some detail. The process of coalification under heat and pressure goes through the following stages: cellulose and lignin to peat to brown coals and lignites to bituminous coals to anthracites to graphites. Cellulose has a linear polymeric structure, but as coalification takes place, this chain structure is replaced by a cross-linked three-dimensional network.

PLASTICS AND DESIGN. W. D. Teague. Arch. Forum *72*, 93–4 (Feb. 1940). A discussion of general principles involved in the use of plastics for architectural purposes.

SYMPOSIUM ON PLASTICS. ASTM Bulletin *1940*, 11–16 (May). Three papers presented at a meeting of the American Society for Testing Materials in Pittsburgh on January 29, 1940. E. R. Perry in "Recent Advance in the Field of Laminated Plastics" reviews industrial applications of these materials. R. L. Wakeman in "Plastics for the Engineer" discusses the thermosetting, thermoplastic, and chemosetting materials, and synthetic rubbers. Gordon Brown in "Comparative Properties of Moldable Plastics" presents a chart called "The Plastics Comparator" to aid in selecting a material for a given application.

TEXTILE FIBERS—OLD AND NEW. Wm. H. Cady. Am. Dyestuff Rept. *29*, P189–97 (Apr. 15, 1940). A review. It is concluded that eventually synthetic fibers will completely replace natural fibers. Cellulose is no longer the sole source of synthetic fibers and in the future may not be the most important source.

Materials and Manufacture

RUBBER FROM PETROLEUM GASES. Dexter North. Chem. & Met. Eng. *47*, 220–4 (Apr. 1940). A description of synthetic rubbers derived from petroleum. The various trade products are classified chemically as follows: Butadiene-styrene—*Buna S;* Butadiene-acrylic nitrile—*Buna N* and *NN*, *Perbunan* and *Perbunan Extra;* Polychloroprene—Neoprene, *Sovprene;* Polyisobutylene—*Vistanex*, *Oppanol;* Polyvinyl alcohol—*Resistoflex;* Polyalkylene sulfides—*Thiokol*, *Perduren;* Plasticized polyvinyl chloride—*Koroseal*, *Flamenol*, *Knightware*, *Igelite*, *Mipolam;* Polyxylene —*AXF*.

PARACOUMARONE-INDENE RESINS. E. R. Coyle. Chem. Ind. *46*, 464–6 (Apr. 1940). Coumarone resins are soluble in a wide range of materials, including coal-tar solvents, petroleum thinners, chlorinated hydrocarbons, ketones, esters, and drying oils. They are compatible with rubbers, waxes, natural resins, bituminous products, and most synthetic resins, and partially compatible with ethylcellulose. They are modern, versatile, and inexpensive.

INFLUENCE OF THE SIZE OF MOLECULE ON THE PROPERTIES OF INDUSTRIAL THERMOPLASTICS. E. G. Couzens, J. A. Hetherington, and L. W. Turner. Chem. and Ind. *59*, 209–14 (Mar. 30, 1940). Actual molecular size, so far as it can be determined, while it certainly influences the strength of plastics of the same kind over a certain range of size, is of little, if any, use for the comparison of plastics of different chemical structure. The feeling of toughness appears to be due to a combination of impact resistance, tensile strength, extensibility, Young's modulus, and bending strength magnitudes.

Molding and Fabricating

ELECTRODEPOSITION ON PLASTIC MATERIALS. J. J. Bayard. Metal Ind. *38*, 255–6, 259 (May 1940). Various methods for making plastics electrically conductive are described. These include application of varnishes or lacquers containing conducting-metal powders, metal spraying, cathode sputtering, metal evaporation, and chemical reduction of silver.

NOTES UPON TESTING MOLD CAVITIES BY TAKING PRELIMINARY CASTS. Brit. Plastics *11*, 494–5 (Apr. 1940). Casting compounds consisting of sulfur and graphite mixtures are used to test cavities for accuracy and finish.

Applications

CLEARING THE AIR. Plastics *4*, 79–80 (Apr. 1940). A description of a new household ventilating fan which, with the exception of the motor, a few screws, and similar small metal parts, is made of a phenolic plastic. The 9-inch four-bladed fan is molded in one piece, the blades being of the latest aerofoil section and of varying pitch for maximum efficiency. The 11-inch flange ring has an internal double thread. Other molded parts include three louvers, the motor housing, and the spider holder for the motor.

LAMINATED MATERIAL FOR JIGS AND FIXTURES. Brit. Plastics *11*, 487–90 (Apr. 1940). Laminated plastics are available in sheets, rods, bars, and tubes of various cross sections and lengths, so that jigs and fixtures can be produced with very little machining. This article discusses German practice in using laminated plastics for jigs and fixtures for light milling operations.

SYNTHETIC RESINS FOR HOSIERY FINISHES. A. Kempton Haynes. Am. Dyestuff Rept. *29*, P186–9 (Apr. 15, 1940). The hosiery trade has become interested in resin finishes because of the permanent improvement in appearance and physical life which can be imparted. Various types of resins for this application are described.

SYNTHETIC ADHESIVES. Plastics *4*, 64–7, 81–3 (Mar. and Apr. 1940). A general survey of adhesives is presented, including the phenol-formaldehyde, urea-formaldehyde, casein, rubber, cellulosic, acrylic, and vinyl resin types, and some special applications.

Coatings

A PISTOL THAT SPRAYS POWDERED METALS AND PLASTICS. R. G. Skerrett. Compressed Air Mag. *45*, 6057–60 (Jan. 1940). The Schori pistol is operated by compressed air which draws the powdered material by an induced suction into the tool, then impels the suspended particles into the zone of the melting flame, and imparts to the molten globules a high velocity that will carry them with an impacting force to the surface which is to be coated. The rates at which the powder is discharged from the pistol and the gases are fed to the flame are susceptible of very nice control. Thiokol has been successfully applied as a spray coating with this equipment.

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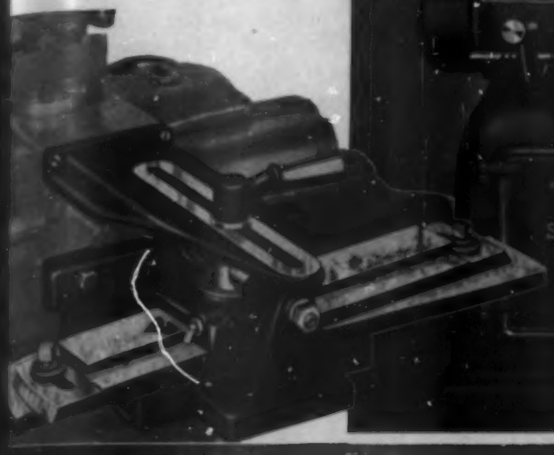
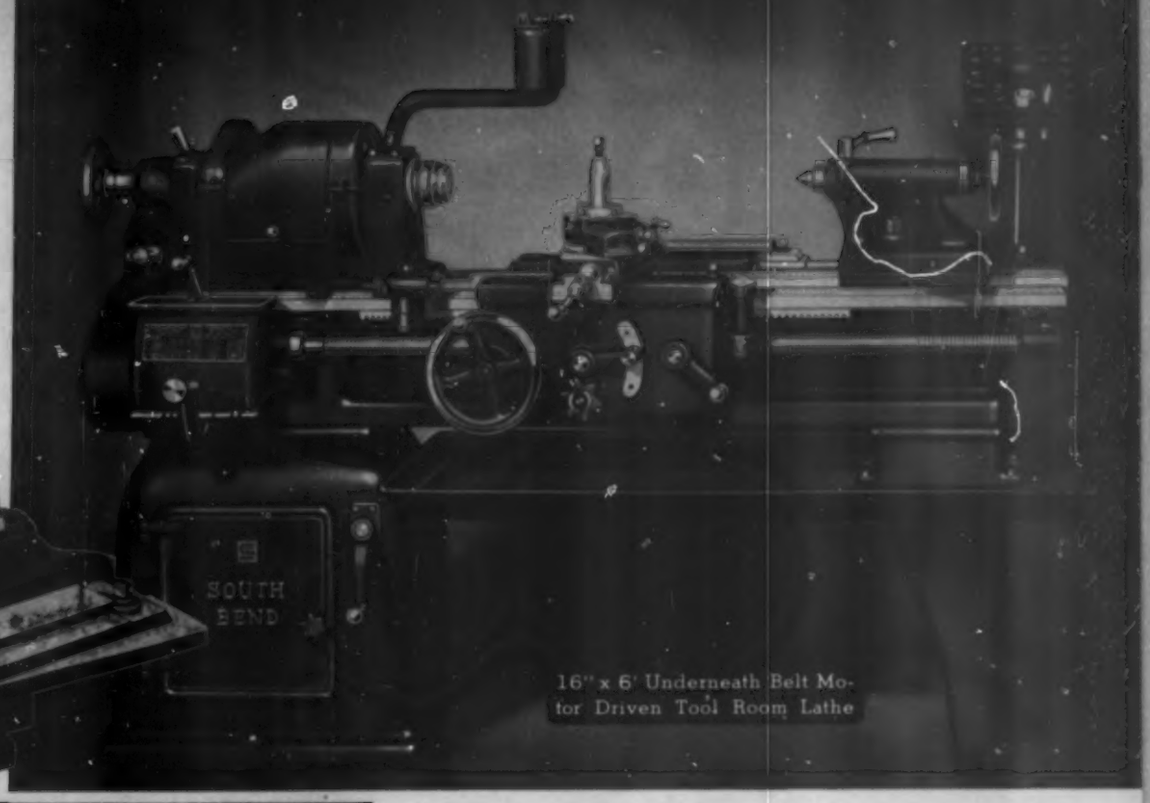
Turns and bores tapers up to 3½ inches per foot smoothly, easily and accurately. Telescopic feature eliminates necessity of disconnecting cross feed screw when taper attachment is in use.





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10-inch swing 1" Collet Capacity Underneath Belt Motor Driven Tool Room Precision Bench Lathe

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U. S. Plastics Patents

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POLISHED MOLDINGS. Daniel Kasen. U. S. 2,168,127, Aug. 1, 1939. Polished sheets or rods of casein plastic are produced by treating the uncured casein material with a polishing solution which may be 5–10 percent aqueous sodium hydroxide or concentrated sulphuric acid; the material is then plasticized by heat, and shaped under pressure in a cool mold so that its polish is retained.

ION EXCHANGE RESINS. H. Wassenegger and R. Griessbach (to I. G. Farb. Akt.). U. S. 2,195,196, March 26, 1940. Diminishing the swelling of cation exchanging resin gels by after-treating the resin with hot hydrochloric, sulphuric or phosphoric acid.

GRINDING WHEEL. S. S. Kistler and C. E. Barnes (to Norton Co.). U. S. 2,195,215, March 26. Bonding abrasive grains in grinding wheels with an alkyd resin in which at least part of the acid component is maleic or fumaric acid.

MICA INSULATION. Wm. H. Miller (to General Electric Co.). U. S. 2,195,254, March 26. Forming shaped insulating units from mica flakes bonded together with a polyvinylal resin.

ALKYD TYPE RESIN. C. Ellis (to Ellis-Foster Co.). U. S. 2,195,362, March 26. An improved procedure for condensing maleic, fumaric, itaconic or citraconic acid with a glycol to form an infusible, insoluble resin.

POLYSULPHIDE PLASTIC. J. C. Patrick (to Thiokol Corp.). U. S. 2,195,380, March 26. Forming a plastic by heating a polymeric polysulphide of ethylene or of longer alkylene chains.

AMINE RESIN. A. G. Hovey and T. S. Hodgins (to Reichhold Chemicals, Inc.). U. S. 2,195,570, April 2. Making a thermosetting resin by fusing a keto acid, e. g., levulinic acid, with an amine.

MOLDING COMPOSITION. H. Schuhmann (to General Electric Co.). U. S. 2,196,033, April 2. Using spun glass as the fibrous filler in a synthetic resin molding compound.

LIGNOCELLULOSE MOLDINGS. A. W. Schorger and J. H. Ferguson (to Burgess Cellulose Co.). U. S. 2,196,277, April 9. A wood product is thermoplasticized by pressure cooking with water at 148 to 199 deg. C. in presence of sufficient alkali to bring the pH within the range of 4 to 6 at the end of the cook, and in presence of 1 to 10 percent of an arylamine; and all water-soluble material is leached out of the thermoplastic product, which is then used in making moldings.

BOTTLE CAP. Richard W. Taylor. U. S. 2,196,345, April 9. A molded screw type bottle cap has a threaded member with a ground seat complementary to the ground seat of the threaded bottle neck; the threaded member is confined within the closure, but only loosely.

RESIN EMULSION. Wm. J. Thackston (to Röhm and Haas Co.). U. S. 2,196,367, April 9. Dissolving a urea-formaldehyde-alcohol resin in a water-immiscible alcohol and emulsifying the solution in water with the aid of a water-soluble cellulose ether and a long chain alkylammonium salt.

GASKET. Wm. B. Atkinson (to Westinghouse Electric and Mfg. Co.). U. S. 2,196,407, April 9. A resilient gasket material comprises about 50 percent by weight of shredded cork and 50 percent of chloroprene polymer.

PRINTING PASTE. M. Belloc (to Société Nobel Française). U. S. 2,196,435, April 9. A composition for printing on fabrics comprises 26 parts of xylenol-formaldehyde resin (modified with ester gum), 14 parts tung oil, 8 parts ethylglycol acetate and 6 parts ethyl glycol.

VINYL RESIN. H. Hopff (to I. G. Farb. Akt.). U. S. 2,196,452, April 9. Condensing monomeric vinylmethyl ketone with formaldehyde in neutral or slightly acid medium, then treating the product with alkali.

CELLULOSE ETHER. S. L. Bass and E. G. Hallonquist (to Dow Chemical Co.). U. S. 2,196,575, April 9. Improving the flexibility, moisture impermeability, nonflammability and dielectric strength of a cellulose ether by plasticizing it with up to 1 percent of a polychlorinated diaryl oxide.

PLASTIC SHEETING. L. M. Currie and L. K. Merrill (to Carbide and Carbon Chemicals Corp.). U. S. 2,196,577, April 9. Making uniformly strong, bubble-free vinyl resin sheeting by superimposing a number of thin resin sheets and subjecting the assembly to pressure, then gradually reducing the pressure while raising the temperature, and finally cooling before finishing the pressure drop.

COATING FOR METAL. R. C. Reinhardt (to Dow Chemical Co.). U. S. 2,196,579, April 9. Permanently bonding a vinylidene chloride to a clean metal surface by means of a layer of vinylidene chloride polymer compounded with a fibrous filler.

RUBBERY POLYMER. V. E. Wellman (to B. F. Goodrich Co.). U. S. 2,196,714, April 9. The polymerization of methyl-vinyl ketone is stopped short of the vitreous stage by adding an inhibitor, so that a rubbery product is obtained.

PLASTICIZERS. J. B. Dickey and J. G. McNally; J. B. Dickey; J. B. Dickey and J. G. McNally (to Eastman Kodak Co.). U. S. 2,196,746; 2,196,749; 2,196,751, April 9. Plasticizing cellulose derivatives with an organic ester of furfuryloxyacetic acid or of tetrahydrofurfurylozyacetic acid; or with a tetrahydrofurfuryl glycol ether; or with a cyclic ether having the structure of an N,N′-dialkoxymethyl-2,6-diaza-4-oxa-cyclohexanone.

VINYL CHLORIDE. G. Wick (to I. G. Farb. Akt.). U. S. 2,196,803, April 9. Molding polyvinyl chloride resin by heat, pressure and mechanical working, without the aid of softeners or plasticizers.

MALEIC ANHYDRIDE RESINS. I. W. Humphrey and J. N. Borglin (to Hercules Powder Co.). U. S. 2,197,046–7–8–9, Apr. 16. Condensing maleic anhydride with dihydrofurfuryl abietate, and using the product as an ingredient in nitrocellulose lacquers; condensing maleic anhydride with tetrahydrofurfuryl alcohol; and condensing maleic anhydride with an unsaturated furfuryl ester in presence of a hydrogenated rosin acid.

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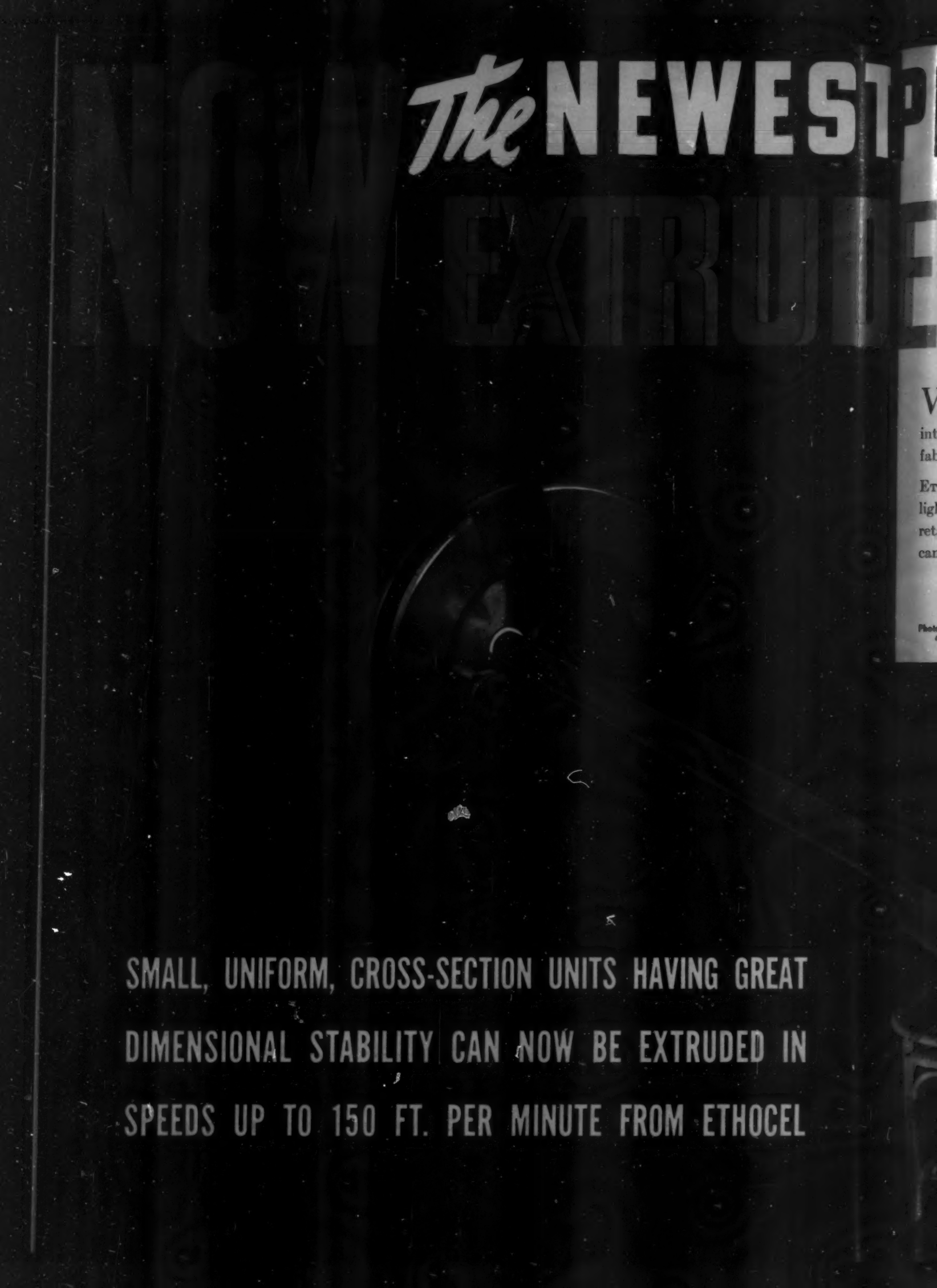

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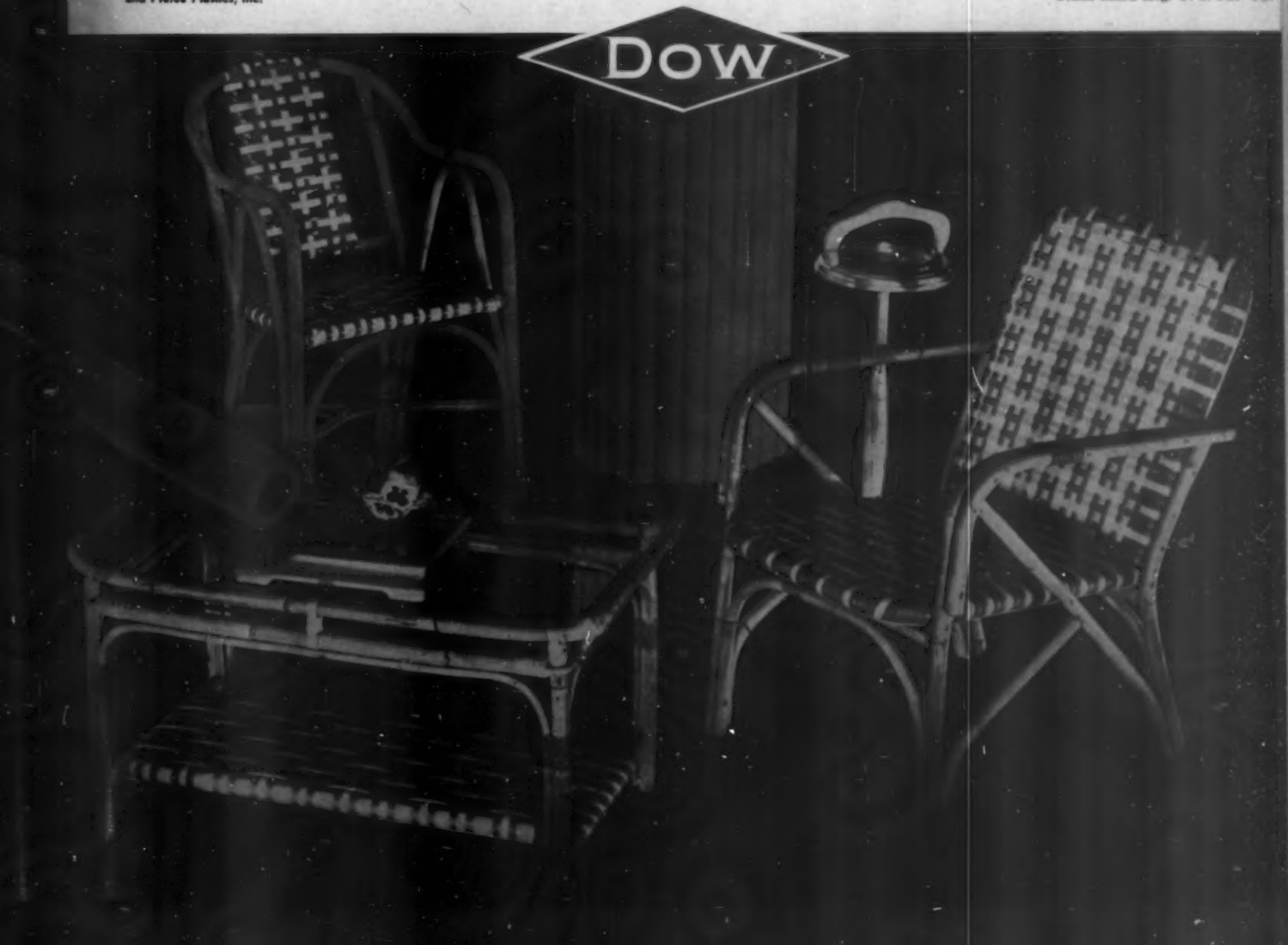

Publications

Write direct to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices.

1939 Book of A.S.T.M. Standards

Published in 3 Parts by the American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa.
Price: $22.00 complete, 2 vols. $15, 1 vol. $8

Important changes are incorporated in this latest A.S.T.M. publication. For the first time it contains all of the Society's specifications, whether standard or tentative. The Book is now issued in three parts, divided as follows: Part I. Metals.—General testing methods and specifications for ferrous and nonferrous metals, except methods of chemical analysis, which are published in a separate book on Chemical Analysis of Metals. Part II. Nonmetallic Materials, Constructional.—Cementitious materials, concrete, masonry building units, ceramics, pipe, timber and preservatives, paints, road materials, waterproofing materials, soils. Part III. Nonmetallic Materials, General.—Fuels, petroleum products, insulating materials, rubber, textiles, soaps and detergents, paper, plastics, water, thermometers.

Each part contains its own table of contents and subject index. The publication in a single volume of the adopted and proposed standard methods for testing any given type of material represents a major change in the previous practice of the Society and one which will undoubtedly be very helpful to test engineers. The Society is to be congratulated upon the excellent job it has done in this general revision of the editorial matter, format, and binding of its triennial Book of Standards. G. M. K.

Industrial Design

by Harold Van Doren
Published by McGraw-Hill Book Co., Inc., New York, 1940
Price $4.50 **420 pages**

Harold Van Doren has turned out a really swell book for those who are serious in their desire for information on the step-by-step procedure of designing products and machines for today's markets. He explains the difference between appearance design and engineering design, gives the reasons for both, and shows how coordination between engineer and designer can bring about sales results obtainable in no other way. One chapter alone, "Gathering the Data," is worth the price of the book and should be read not only by aspiring students, but by every manufacturer and professional designer as well.

The book is divided into four parts with twenty-seven chapters, glossary, and bibliography, is well illustrated, and contains a wealth of information for individuals interested in following design as a vocation. It is well planned and assembled for ready reference by engineers, draftsmen, advertising men, or any others faced from time to time with the problems of appearance and workability of a product they are about to create. It is sufficiently complete to provide a workable course in the important subject of Industrial Design for almost any school.

Van Doren, a pioneer in Industrial Design, has earned his fame in the field by continually creating products with successful sales records over the past ten years. E. F. L.

BESBEE PRODUCTS CORP., TRENTON, N. J., HAS issued a specification folder describing molded plastic letters to be used on sign or display backgrounds.

A COMPREHENSIVE 136-PAGE CATALOG OF SAFETY appliances for protecting both operator and machine has been released by the Boyer-Campbell Co., 6540 Antoine St., Detroit.

Commodities in Industry

Prepared and published by Commodity Research Bureau, Inc., 82 Beaver St., New York, 1940
Price $7.50 **720 pages, 200 illustrations**

Particularly interesting to business and industry at this time, the analysis of the effects of the last World War on the general price level is one of the highlights of the 1940 Commodity Year Book. The editors conclude that a commodity price boom in the U. S. will be the inevitable result of the current war in Europe with such factors as inflation, restrictions in production, destruction and waste of materials, hoarding, rationing, transportation difficulties, rising shipping and insurance costs having important effects.

The complete story of basic commodities and their influence on national economic, social and political conditions is discussed. Original research studies are concerned with the challenge of synthetics and plastics to the use of basic commodities, the shifting trends of per-capita consumption, new methods whereby raw materials are converted into finished products, etc. There are separate analyses of 75 basic commodities supported by charts and tables, in addition to general discussions. H. B. J.

CHICAGO WHEEL & MFG. CO., 1101 W. MONROE ST., Chicago, has prepared a 22 in. by 15 in. (pictorial wall chart which shows actual size and shape of every standard mounted grinding wheel made by the company. Ideal for ready reference in the shop, the chart gives full specifications, mandrel sizes, etc. The company has also issued a new illustrated 64-page booklet describing the Handee all-purpose tools for drilling, polishing, grinding, cutting, carving, etc., and accessory Handee products. Write direct to the company for free copies.

RECOMMENDED USES AND PIPING DIAGRAMS OF thermostatic, expansion, weight-operated and piston-operated steam traps are contained in a new catalog issued by W. H. Nicholson & Co., Wilkes-Barre, Pa.

DETAILED RECOMMENDATIONS ON HOW TO MAchine and fabricate vinyl resins by common woodworking and metalworking methods are given in a new booklet, "Fabricating Processes for Vinylite resins," published by The Carbide and Carbon Chemicals Corp., 30 East 42nd St., New York. The booklet describes the best methods of machining, drilling, sawing, tapping and threading, grinding and polishing molded articles and sheets of these resins.

One chapter tells of latest developments in laminating, embossing, drawing, blowing, rolling, stamping and cementing sheets; while another section is devoted to over-lacquers and wipe-on paints. Complete tables of the available forms and properties of filled and unfilled Series V resins are also presented.

STRIP HEATERS, CALROD IMMERSION HEATERS FOR water and oil, forced and natural-convention type unit heaters, fin calrod and cartridge type heating units and thermostats for midget heating units are described in a series of new bulletins (Nos. 1157C; 214D; 2592A; 2618A; 104B and 1265D, respectively) issued by General Electric Co., Schenectady, N. Y. Three new glyptal resin welding aids for producing a finished appearance and durability of arc-welded products are described in Bulletin GEA-3198A.

RAYMOND BOWL MILLS FOR DIRECT FIRING ROTARY kilns are illustrated and described in a new folder issued by Raymond Pulverizer Div., Combustion Engineering Co., Inc., 1324 North Branch St., Chicago.

SAMPLES OF COLORS, PATTERNS AND WOOD GRAINS available in various forms of Formica laminated plastic are conveniently presented in a new chart issued by the Formica Insulation Co., Cincinnati, Ohio.

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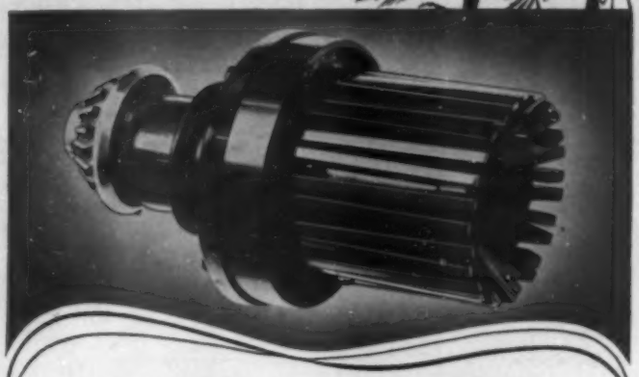

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Equipment

A SCIENTIFIC METHOD OF DETECTING MOISTURE content of plastic materials, chemicals, ceramics, textiles, etc., is claimed possible with the Delmhorst Detector. This utilizes the electrical principle of measuring the electrical resistance between two electrode points forced into the material. Since the resistance usually varies in direct proportion to the amount of moisture, the percentage of the latter is calibrated on the dial of the instrument and thus moisture readings can be made instantly. The apparatus consists of a portable metal case housing the instrument and dial divided into 100 divisions. A rugged electrode is attached which is plunged into the material to be tested. The dial-knob is turned until indicator lamp lights.

THREE NEW COLLET INDEX FIXTURES HAVE BEEN developed by Hardinge Brothers, Inc., for milling, grinding, shaping, and other tool room operations. Besides being a means for holding work, they are claimed to allow rapid and accurate indexing. The new fixtures are designed to meet any position requirement or combination of requirements and collets are interchangeable for all machines.

THE HANNIFIN NO. 10 TOOL ROOM MACHINE (SHOWN above) combines in one compact unit a precision lathe, sensitive drill press, horizontal milling machine, and vertical milling machine. This one versatile machine, the company reports, allows completion of most operations on one machine, saving time and increasing work capacity. In addition to unusually convenient handling of regular tool room work, the machine may be used for economical production of many kinds of parts manufactured in small quantities, according to the release.

VARIOUS TYPES OF WELDING HELMETS AND ACCESsory protective appliances and equipment for safeguarding against industrial accidents and workmen's injuries are manufactured by Mine Safety Appliance Company.

A NEW SELF-CONTAINED HOT PLATE PRESS FOR laboratory or production work is offered by Baldwin Southwark Division, Baldwin Locomotive Works. The press (illustrated above) has a capacity of 115 tons; 24 in. by 24 in. platens and a 6-in. stroke. A two pressure pump is driven by a 3-hp. motor. A conveniently located work table and single handwheel control are designed to minimize mold handling and reduce operator fatigue. A saving in power costs is said to be secured on long cures because the pump need not run continuously to maintain a predetermined pressure. Side slab construction is an assurance of positive platen alignment and tends to reduce radiant heat losses. Pressure may be quickly adjusted from the front of the unit over a wide range up to 1150 lb. per sq. in. Either steam-heated or electrically heated platens are furnished.

MANY IMPROVEMENTS HAVE BEEN MADE IN THE 1940 model Easy Electric sander, according to the Detroit Surfacing Machine Co., manufacturer. Increased power, perfected drive mechanism, better balance are said to provide smooth convenient operation of this portable tool on horizontal or vertical surfaces of plastics, metals, or composition materials.

A FLOOR-TYPE UNIT, SINGLE SPEED GRINDING machine which mounts two 20-in. wheels has been added to the Hammond Machinery Builders' line of similar equipment. The driving motor is mounted in the base with V-belt connection to a $3^7/_8$-in. spindle. This spindle is made of high-carbon steel in two parts joined by a coupling which serves as a means for assembly of the belts or for their replacement. A hinged hood covers the driving compartment and wheels are equipped with guards and adjustable tool rests.

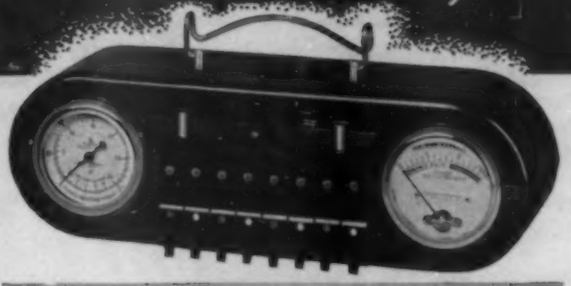
FLEXIBLE SHAFT MACHINES FOR GRINDING, SANDing, wire brushing, drilling, buffing, polishing, filing, etc., are available from Snow Mfg. Co., Inc. New truck models, adjustomat and radial arm models and accessories such as grinding wheels, buffs, as well as the flexible shaft units for various type mechanisms, are featured by the company in a recent catalog.

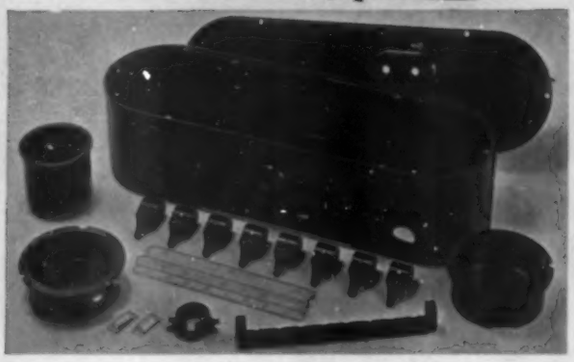
R. W. CRAMER CO., INC., HAS RECENTLY PLACED on the market a Synchronous Motor-driven Time Delay Relay which is designed for use on alternating current circuits to supply an adjustable or a fixed-time delay between closing of one circuit and subsequent closing or opening of another.

DESIGNED FOR THE CONTROL OF SPEED, HAND tachometers, speed indicators, cutmeters, tachographs, stopwatches, tachoscopes, supplied by George Scherr Co., measure revolutions per minute of electric motors, machinery, engines, lathes, pumps, and other industrial equipment.

COMPLICATED!

-but IMPERIAL MOLDED made it look easy





WHEN the Warner-Patterson Company asked us to work on the problem of making a molded assembly of their new Warner Portable Motor Analyzer it looked like a mighty tough job—but we welcome hard molding jobs because they enable us to demonstrate the full value of our plant and experience.

The pictures above show just how we solved the problem—how we worked out 18 molded parts that were held to tolerances of .001" to .004", depending on the part.

These parts had to fit together, and also had to fit the operating mechanism of the unit. The case involved a deep draw, with side cores and horizontal bosses—a very difficult molding job.

The assembly was made up of:

1 Case	1 Pressure Gage Case
1 Back	2 Molded Transparent Lenses
8 Switches	1 Neon Tube Panel
1 Switch Bracket	1 Thermocouple
1 Volt Meter Case	1 Solvent Cup

The resultant simplified assembly is low in cost, light in weight and provides maximum electrical and heat insulation.

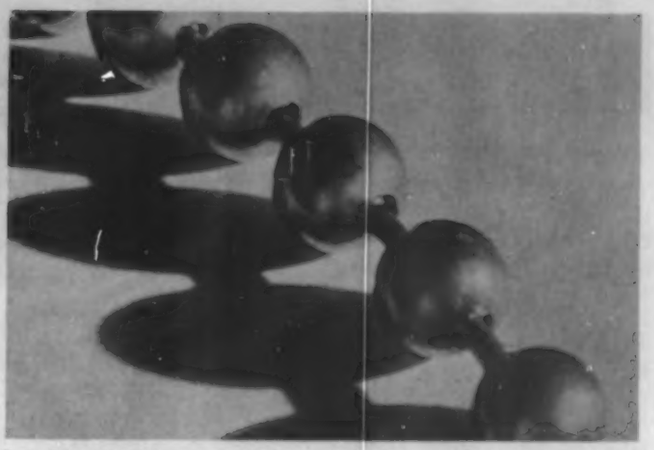
Whether you have a complicated problem or a simple molding job, we should like the opportunity to demonstrate how we can handle it in any plastic material.

IF YOU REQUIRE PULLS, KNOBS AND HANDLES— don't overlook our unusually large stock assortments. Bulletin K-100 shows all the latest styles, colors and specifications.

IMPERIAL MOLDED PRODUCTS CORP.
2927 West Harrison Street, Chicago, Illinois

IMPERIAL *Plastic Molding*

Bakelite • Plaskon • Durez • Tenite • Beetle • Lucite



INGENUITY

BEAD CHAIN*

Smooth, round metal beads, held by swiveled couplings—this is BEAD CHAIN,* that will not kink nor tangle. It is available in varied metals and finishes in bead diameter sizes from $^{3}/_{32}$ to $^{3}/_{8}$ inch. For over 25 years it has been successfully and ingeniously used with many products.

BEAD CHAIN

ESTABLISHED 1914

Trade Mark Reg. U.S. Pat. Off.

With your ingenuity and ours it is possible that BEAD CHAIN* can be advantageously adapted to your product.

THE BEAD CHAIN MANUFACTURING CO.

*Reg. U.S. Pat. Off. 60 MT. GROVE ST., BRIDGEPORT, CONN.

They Say

THE PLASTICS INDUSTRY IS NOW REPRESENTED AT the 1940 Golden Gate International Exposition in San Francisco by an exhibit in the Hall of Science. A comprehensive display of outstanding applications of plastic materials as represented by the winners and entries in recent MODERN PLASTICS Competitions has been prepared by MODERN PLASTICS and set up under the supervision of Wendell McMahill of the Fair. Decorative architectural products, household and fashion accessories made from a wide variety of plastics are included, ranging in size from tiny insulators, accurate to a thousandth of an inch, to mammoth agitators and huge molded and laminated parts. In addition to the general exhibit, there are several displays of basic raw materials tracing their development from prime constituents down through stages in their manufacture.

CONSTRUCTION WORK ON A NEW $50,000 BUILDING for the plastics department of the General Electric Co. is expected to be completed June 15, G. H. Shill, manager, has announced. The structure, 165 ft. long by 75 ft. wide, is to be one story and will be used for the development of new plastics on a small scale production basis and will be erected about 75 ft. south of the present plant. It will comprise 6000 sq. ft. of floor space for manufacturing and an equal amount for warehouse facilities.

IN ANSWER TO THE MANY REQUESTS FOR INFORMATION regarding Louverglas, we wish to report that no official data have been released regarding the properties and availability of this material. We understand that this plastic is a clear cellulose acetate sheet material intended for use in connection with fluorescent lamps and other lighting equipment. Experimental samples of the material reveal that there are thin films of opaque colored pigment in suspension within the body of the plastic and extending from face to face of the sheet. These films are arranged to function as minute louvers for the control of light. A more detailed article describing this material will appear in our editorial pages when it comes out of the development stage and is ready for more extensive commercial application.

HEYDEN CHEMICAL CORP., 50 UNION SQUARE, NEW York, announces that at the directors' meeting held May 16, 1940, Eric Rathje and John Paul Remensnyder were elected assistant vice presidents of the company.

DAVID SWEDLOW CORP., GLENDALE, CAL., HAS APpointed Transparent Plastic Products Co., Los Angeles, as its exclusive industrial sales representative. It is understood that the latter organization will operate on a national scale and will shortly appoint sales representatives in all important key industrial centers.

OFFICERS OF THE RECENTLY ORGANIZED MICHIGAN Molded Plastics, Inc., custom molder, according to a recent announcement, are: James T. Libbey, president; L. W. Seybold, vice president and treasurer; H. S. Reynolds, secretary; John G. Rossiter, general manager; I. H. Whitman, plant manager.

CONSTRUCTION OF A NEW PLANT IN SPRINGFIELD, Mass., for the manufacture of Resinox phenolic plastic molding materials was announced recently by John C. Brooks, vice-president of Monsanto Chemical Co. and general manager of the company's Plastics Division. Construction was authorized by the board of directors of Monsanto in a meeting in St. Louis, and work will begin as soon as contracts can be let.

The present Resinox plant is at Edgewater, N. J. Resinox Corp. was purchased by Monsanto from Corn Products Refining Co. and the Commercial Solvents Corp. in May, 1939.

PLASTIC MILK BOTTLES RECENTLY HAVE BEEN favored with considerable ill-timed publicity by the daily and weekly press with the result that every manufacturer of plastic materials as well as those who make milk bottles have been flooded with requests for further details.

It was reported that National Dairy Products Corp. were testing new transparent plastic milk bottles but the statement has been denied by officials of that concern.

We, too, have been beseiged with requests and can only reply that to the best of our knowledge and belief there is no transparent plastic available at the moment which could be used economically or efficiently for such a purpose.

Experiments, of course, have been carried on for some time. Plastic bottles have actually been made—some of them in the shape of milk bottles—but none are available for commercial purposes nor are they likely to be until some new plastic material is developed which will meet the practical and exacting requirements of the dairy trade.

SYNTHETIC MOULDED PRODUCTS, INC., STONINGton, Conn., reports it is building a new factory at Wakefield, R. I., which will triple its present capacity and extend its line to dress buttons, bottle caps, electrical parts, and industrial moldings.

NEWEST ENTRANT INTO THE DISPLAY AND DECORAtion fields is an inlaid fluorescent laminated sheet material made by Formica Insulation Co. illustrated by the display above. When regular white light is turned off and ultraviolet "black" light is turned on, inlaid figures of various designs glow in a variety of beautiful color effects.

The fluorescent effect is produced by chemicals which have the property of converting the invisible ultra-violet light into visible light. The effect is different from phosphorescence in that it stops immediately when the ultraviolet irradiation is stopped. The effect is more pronounced when shown in the dark—a semi-lighted room gives proportionately less effect. The rays of the H4 ultraviolet light are said to have no harmful effect on skin or eyes. The fluorescent colors, the company reports, are not as light-stable as regular pigment colors and are not recommended in direct exposure to the sun.

AUBURN BUTTON WORKS, INC., AUBURN, N. Y., reports that G. P. Anderson has been elected vice president and general manager of the company. (*Please turn to next page*)

GIVE US AN IDEA....

and we'll mold it

Universal closes the gap between the idea and the finished product because we make our own molds.

We maintain our own tool and machine shops to render this important service to our clients as part of the complete molding service we offer —from design to assembly. Our complete battery of all types of presses —injection and compression—is a guarantee of prompt production. Our experienced, efficient finishing and assembly departments round out our complete plastics service.

Send us a blueprint or tell us about your idea—our engineers are completely at your service without obligation.

remember—UNIVERSAL "means everything in plastics"

UNIVERSAL *Plastics Corp.*

Factory: 235 Jersey Ave.
New Brunswick, N. J.

New York Office:
500 Fifth Avenue

The most modern molding press will be inefficient

UNLESS . .

A COLTON PREFORMING

machine backs it up!

Colton Preforming Machines are the accepted standard in the plastics industry not only because they speed up the molding cycle but because their unvarying accuracy of performance is a guarantee of better molding at the press. When Colton preform pellets are used material waste is eliminated, flash is held to the ideal minimum, material handling problems are simplified and costs d
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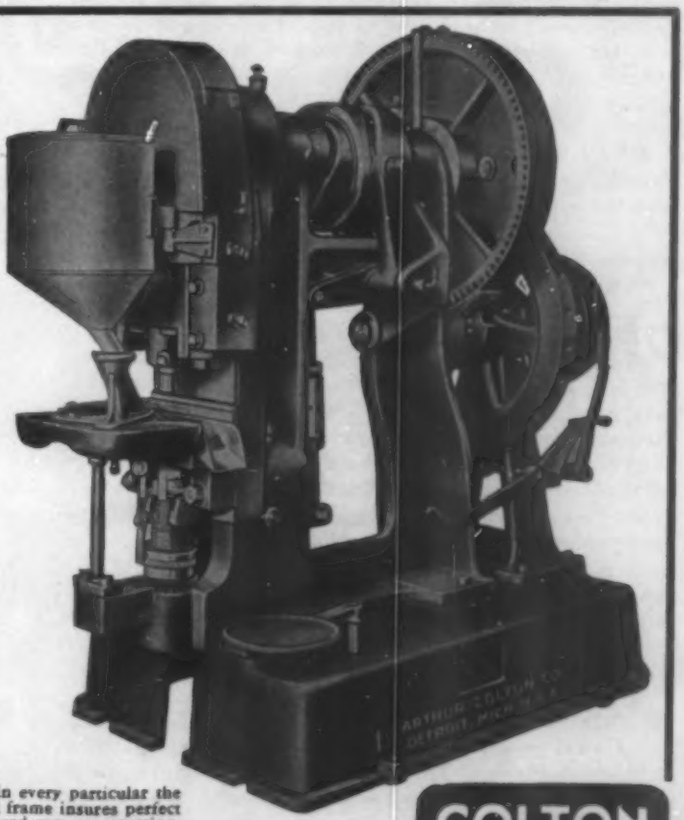
Write us for full details about our complete line of single punch, multiple and rotary preforming machines.



ARTHUR COLTON CO.
2604 E. JEFFERSON AVENUE
DETROIT, MICHIGAN

The new improved 5⅛ tablet machine—in every particular the finest the market has to offer. Solid steel frame insures perfect operation; improved die fasteners, improved cam construction, heavier ejecting mechanism, vanadium steel plungers—make high speeds possible without fear of breakdown or lowered quality. Makes tablets up to 3" in dia. having a fill depth up to 2⅛".

COLTON
DETROIT

THE FORMICA INSULATION CO., MANUFACTURER OF laminated material for electrical insulation and mechanical applications, as well as a line of plastics as finishing material for furniture, fixtures, and building purposes, reports that it has begun the erection of a plant addition, amounting to about 30,000 square feet. This will add two stories to the present plant building. The company says it has been oversold and behind on deliveries since last September and an extension became absolutely necessary.

HYGIENIC TUBE & CONTAINER CORP. REPORTS THE change of its name to Celluplastic Corp. Personnel and management are the same and offices remain at 50 Ave. L, Newark, N. J.

NATIONAL PLASTIC PRODUCTS CO., 1349 EAST MILwaukee Ave., Detroit, distributor, informs us of the addition of cellulose acetate butyrate extruded plastics to its line. Also, it has installed tanks and baths for bending and fabricating acrylics and is planning to manufacture transparent furniture.

ALLAN BROWN, ADVERTISING MANAGER AND DIrector of public relations of Bakelite Corp., Unit of Union Carbide and Carbon Corp., New York, has received an award from the Technical Publicity Association for "Distinguished Services in the Cause of Technical Advertising." The award was made to Mr. Brown at an executive session held at the Hotel Pennsylvania in an All-Day Seminar Conference celebrating the 35th Anniversary of the association, of which Mr. Brown has served as president. Mr. Brown has also served as president of the National Industrial Advertisers Association, and as chairman of the Association of National Advertisers.

A SURFACE TREATMENT FOR NON-CONDUCTING materials such as phenolic products, wood, ebonite, etc., permitting such materials to be electroplated, has been developed and patented by Acheson Colloids Corp., Port Huron, Mich. The treatment consists of applying a coating containing a hardenable organic colloid, a hardening agent and colloidal graphite, suspended in water, to the part by dipping, brushing or spraying, etc. The coating, it is reported, hardens on exposure to light and renders the surface conductive, permitting the electrodeposition of copper, as an example.

A SIXTY-YEAR CELEBRATION HONORING THREE OF its employees who completed 60 years of uninterrupted service with the company was held May 10 by the S. S. White Dental Mfg. Co., New York. Besides the guests of honor, D. W. Sprague, C. E. Boyd, and W. H. Berke, five other employees who worked for more than 50 years were also honored.

A RECENT STORY IN THE *VINEYARD GAZETTE*, published by Henry Beetle Hough, Edgartown, Mass., says that Ralph H. Bodman of that town is establishing a plant to make pearl essence plastics to be used in the manufacture of vanities, cosmetic cases, etc. Mr. Bodman will make the pearl essence from fish scales of which there is a plentiful supply in the waters off the Massachusetts coast. Mr. Bodman also claims to have a pearl-like plastic which will withstand successfully the temperatures required for injection molding.

A COMPLETE LINE OF CARPENTER TOOL STEELS ARE now being stocked in Dayton, Ohio, by Industrial Steel Service, warehouse division of Dayton Fabricated Steel Co., 130 East Monument Ave., we are informed by the manufacturer.

M AND M WOOD WORKING CO., PORTLAND, ORE., fir plywood manufacturer, has designed a selling kit titled, "Resnprest Plywood Means Business." It contains specific examples of both interior and exterior applications and there are 12 special inserts, each devoted to a particular field, with complete selling information plus detailed explanations and pictures of applications and uses of waterproof exterior plywood. A general folder covering specifications is also included.

E. I. DU PONT DE NEMOURS & CO., INC., REPORTS that at a recent directors' meeting, Pierre S. du Pont retired as chairman of the board and was succeeded by Lammot du Pont, formerly president of the company. Walter S. Carpenter, Jr., a former vice president and chairman of the finance committee, was made president. Angus B. Echols, a vice president, was elected to Mr. Carpenter's former position. J. B. Eliason, treasurer, now becomes a vice president and director in addition. Pierre S. du Pont, Irénée du Pont and Lammot du Pont will continue as members of the board and of the finance committee.

O. W. G. DOLL, A MEMBER OF THE FIRM OF DOWDING & Doll, Ltd., London, England, is visiting in the United States. This organization is the distributor of the Lester injection molding machine and Lester die casting machine in England and Continental Europe.

POLYXILE, A NEW DARK, THERMOPLASTIC RESIN made from chemical derivatives of wood and other cellulosic materials, has been developed by the Polyxor Chemical Co., Inc., New Haven, Conn. The material is manufactured in several grades of different hardness. It is dissolved by many organic solvents, such as ketones, pinene, chlorinated hydrocarbons, etc.

These solutions can be applied by spraying, brushing, or dipping, and the coating can be further processed by heat treatments. According to the company, the coatings are stable at temperatures over 150 deg. C., and are not attacked by caustic alkaline solutions or acids, with the exception of highly concentrated sulfuric or acetic acids at elevated temperatures. Special grades are said to be stable against nitric acids.

VICTOR A. KELLER, BRITISH INVENTOR AND pioneer in plastics with more than 60 patents reported to his credit, has accepted a long term contract with Thompson's, Ltd., 305 East 46th St., New York, with whom he has been associated since 1938. Mr. Keller's services as a plastic consultant will be available through this company.

THE SYNVAR CORP., 105 LOMBARD ST., WILMINGTON, Del., reports it is putting on the market a new line of urea resins for laminating purposes and for use in the bonding of plywood, the bonding of thin veneers to composition boards, wall boards, asbestos boards, cork, and for decorative panels of all kinds for furniture, airplanes, etc. The urea bonding resins are not intended for conditions where the bond is exposed to weather and moisture. For extreme conditions the phenol bonding resins are necessary, and are available, the company tells us.

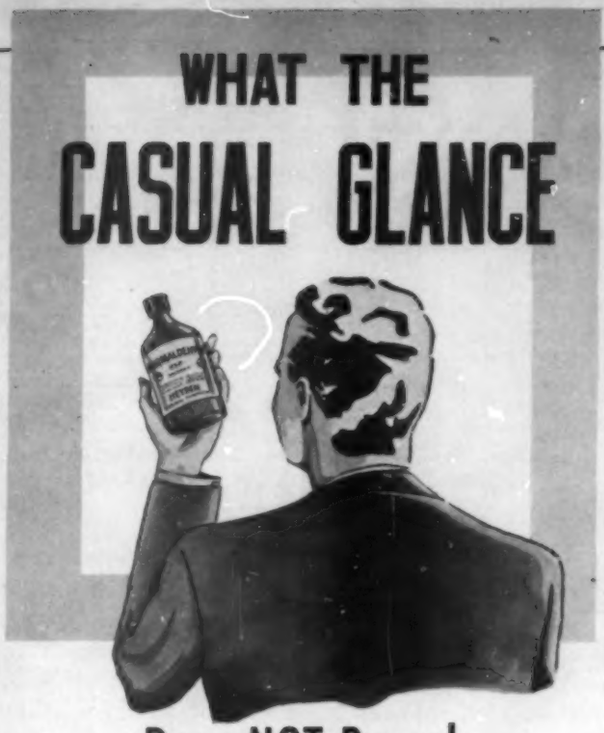
A feature of these resins is that they can be supplied for hot press use where such equipment is available, and also for cold press use—the bonding action taking place at room temperature, it is claimed.

PAUL R. MACALISTER, A.I.D., FOUNDER AND FORMER director of PEDAC, Rockefeller Center, has opened offices at 1 East 53rd St., New York, which he says will be devoted to interior architecture, design and decoration.

KELSANITE, A LATEX MOLD MAKING COMPOUND developed by the Kelsan Products Co. St. Clair, Mich., is said to reduce to a minimum the factor of mold shrinkage, thus overcoming one of the difficulties often experienced with the use of latex molds for casting novelty products such as book-ends, busts, etc. The material is claimed to be self-vulcanizing and to air-cure at room temperatures. Special instructions for using the material are available from the manufacturer.

ON MAY 9, THE PLASTICS DIVISION OF MONSANTO Chemical Co. opened its new central research laboratory at Springfield, Mass. The building is designed to provide modern research equipment and in addition to laboratory facilities, and includes a number of testing machines and pilot plant units developed by the company engineers.

WHAT THE CASUAL GLANCE



Does NOT Reveal

The casual glance may not reveal the high purity and uniformity that characterize Heyden Chemicals. But these advantages can be checked by the same precision methods used in the Heyden Laboratories. FORMALDEHYDE, first produced commercially in the United States by Heyden, is an excellent example of how quality can be constantly improved through research and control.

Specify **HEYDEN**

FORMALDEHYDE U. S. P.

37% by weight - 40% by volume

A water white solution of full strength and high uniform purity. Carboys – Drums – Tank Trucks and Tank Cars.

Other HEYDEN CHEMICALS include:

PARAFORMALDEHYDE
HEXAMETHYLENAMINE
BENZOIC ACID
SALICYLIC ACID
BENZALDEHYDE
BENZYL CHLORIDE
PENTAERYTHRITOL

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HEYDEN
CHEMICAL CORPORATION
50 UNION SQUARE • NEW YORK
CHICAGO BRANCH: 180 N. WACKER DRIVE
FACTORIES: GARFIELD, NEW JERSEY FORDS, NEW JERSEY

Results Accurate

—WHEN TRANSLATED INTO TERMS OF PRODUCTION

Laboratory results obtained on the Elmes Hydraulic Laboratory Press are accurate and dependable—they can be used as the basis for production plans. Time, money, needless duplication of tests can be saved with this precision instrument.

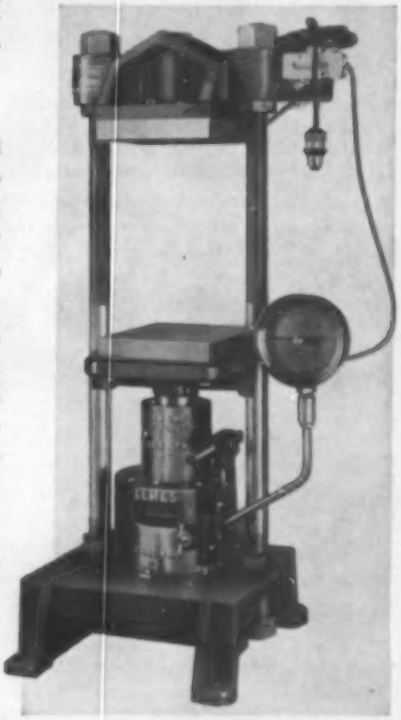
Designed particularly for the fast-moving, quick-changing plastics industry to cut down that time gap between laboratory results and production profits. Built in accordance with the same high standards Elmes maintains for presses large or small.

Here are some of the special features which will make this press particularly usable in your laboratory:

1. Maintains constant pressure against a dead head for an indefinite time—achieved through a new valve and a specially designed packing.

2. Adaptable to a wide variety of applications.

3. Entirely self-contained.



THE ELMES HYDRAULIC LABORATORY PRESS

Ask for complete details. Let us tell you how these presses can be applied to your laboratory *and production problems.* No obligation to get the facts. Write today.

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Montreal and Toronto.
Williams & Wilson, Ltd.

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225 N. MORGAN ST. *Chicago* SINCE 1851

Permanence of physical properties of plastics

(*Continued from page 68*) setting compounds results in improved physical properties, though some exceptions have been noted.[31] In phenolics, for example, the additional polymerization incurred on exposure to elevated temperatures, is accompanied by internal shrinkage in the material as the phenolic constituents attach themselves to the main primary bond structure through methylene linkages. Nevertheless, the results of Fig. 18 are quite interesting, for only slight differences were noted for a molded article with 1-, 2-, and 10-min. curing periods in the mold. The measurements were made with a 4- to 5-in. micrometer upon a 4.5-in.-diameter molded ring and are accurate to plus or minus 0.0001 inch. It was expected that the poorly undercured 1-min. sample would shrink considerably more than the overcured, whereas only a slight difference was recorded. This observation has been corroborated by other investigators.[32]

Application of excessive temperatures of 500 deg. F. produced swelling in a very short period of time due to the thermal disintegration of the resin molecule. One must assume that the prime molecular structure of the materials is developed during the period the material is molded under heat and pressure. Further changes in polymerization outside of the mold must result in a reduction of soluble stage *B* resin constituents which Houwink assumes as being present within a strong, polymerized primary molecular structure.[4] Chemical, electrical, and physical properties may be expected to improve through a reduction of these constituents, providing the temperature is not too high to be detrimental to the resin or its filler. For a discussion of other possible effects produced by aging in phenol-formaldehyde products, there are other studies.[33]

Fig. 18—Shrinkage of molded phenolics on high-temperature exposure for different cubes

(A 1 min. cure; B 2 min. cure; C, 10 min. cure)

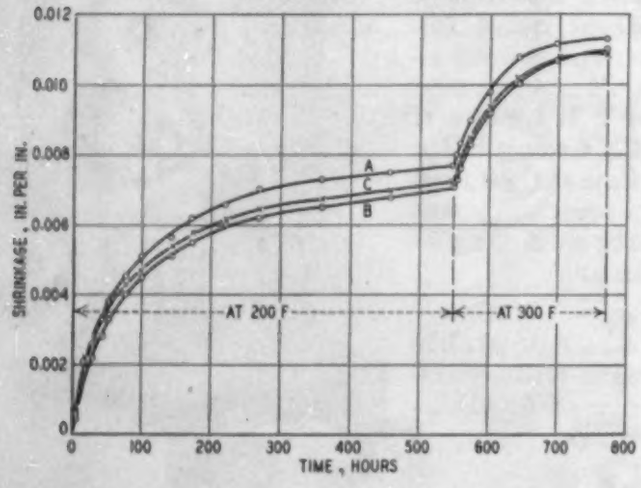
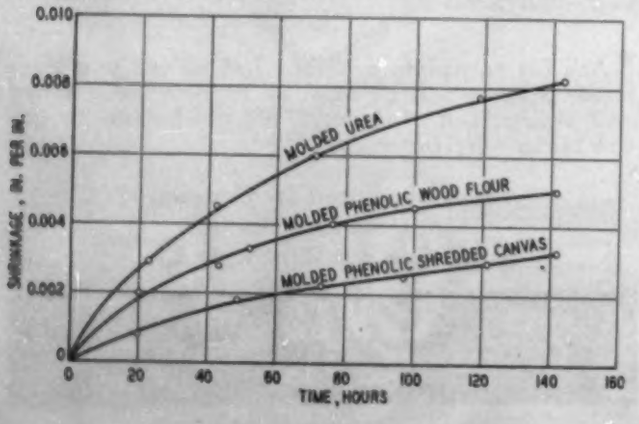


Fig. 19—Shrinkage of molded plastics at 200 deg. F.



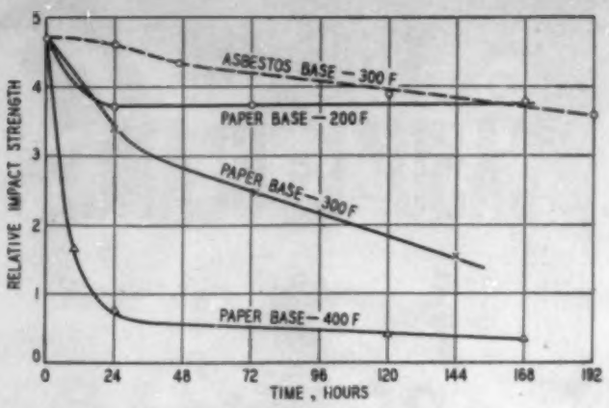


Fig. 20—Effect of temperature exposure on impact strength of laminated phenolics

In summarizing the discussion of the shrinkage of hot-molded phenolics and urea plastics, the significance of time and of temperature must be pointed out again. For example in Fig. 18 (which employed *Bakelite* molding composition no. 8041), a limit in the amount of aftershrinkage was indicated when the material was maintained at 200 deg. F. Continuance of the temperature exposure at 300 deg. F. after 550 hrs. revealed more than a 50 percent increase in aftershrinkage. After the specimens were removed from test and left to stand in the atmosphere, a slight swelling was observed after several weeks, due to the absorption of moisture, though this new over-all dimension was considerably smaller than the original dimension.

The effects of increasing temperature upon thermoplastic materials are quite marked. If they are under stress, they will distort readily, particularly as the temperature approaches their heat-distortion point. If not under mechanical stress, as for example an electrical insulating coil bobbin, they may be used above their heat-distortion point. It must be pointed out, however, that cellulosic products which are usually highly plasticized, will suffer a loss of plasticizer content and residual solvent and become embrittled if exposed to excessive temperatures for too long a period. Shrinkage in molded cellulose-acetate articles will also be due to loss of moisture content. In comparison

32. Shrinkage of Molded Plastic Articles, by J. F. Kanavets and K. P. Sedova, Organic Chemical Industry, Moscow, U.S.S.R., 5, 1938, pp. 508–513.

33. Effects Produced by Aging in Synthetic-Resin Molded Products of the Phenol-Formaldehyde Group, by E. J. Casselman, Trans. of the American Electro Chemical Society, 44, 1923, p. 43.

CLASSIFIED

WANTED: Stainless Steel or Nickel Kettle, Vacuum Pan, Hydraulic Press, Preform Machine and Mixer. Reply Box 275, Modern Plastics. No Dealers.

PLASTIC MIXING & MOLDING EQUIPMENT—Factory rebuilt—Hot Rolls or Mixing Mills, Hobbing and Die Sinking Presses, Semi-automatic and Standard Molding Presses, Hydraulic Pumps, Accumulators, Intensifiers. Reply Box 294, Modern Plastics.

YOUNG MARRIED MAN: 28, wishes position with small moulder or someone just going into business, as moulding technician. Have ten years experience in moulding the following: Bakelite, Plaskon, Beetle, Tenite, Lumarith and Durez by the compression method in both hand moulds and automatics, in one of the country's largest and most modern plants. I also have injection press experience and capable of taking care of production end. Employed, but immediately available to go anywhere. References. Reply Box 358, Modern Plastics.

FOR IMMEDIATE SALE: 18 Semi-Automatic Hydraulic Presses —300 Ton, 18" Ram, 30x25" & 27"x25" Platens, 2500#. 125 Ton, 12" Ram, 23"x17" Platens, 2500#. Large stocks Hydraulic Presses, Pumps & Accumulators. Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizers, Tumbling Barrels, Drill Presses, Lathes, Gas Boilers, etc. Send for Bulletin #156 and #128. We also buy your surplus machinery for cash. Reply Box 359, Modern Plastics.

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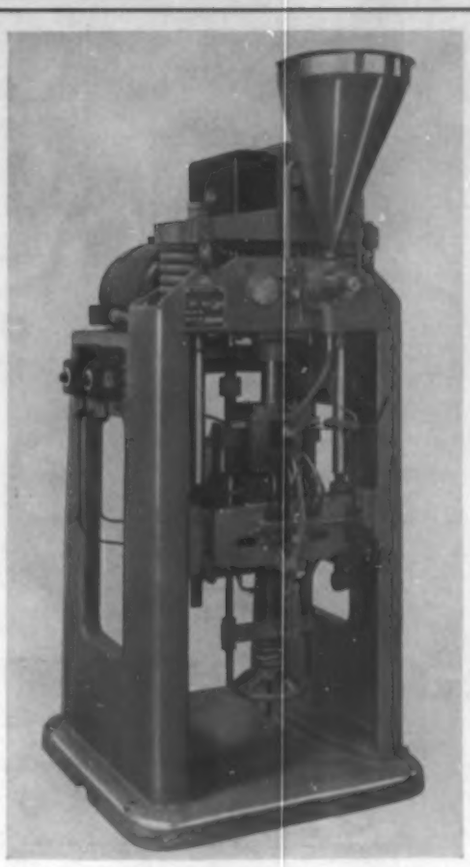

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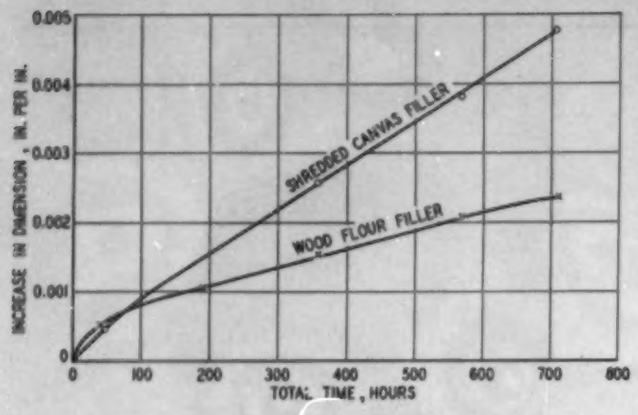

Fig. 21—Dimensional stability at high humidity for hot-molded phenolics

(At 86 percent relative humidity; 85 deg. F. temperature; wall thickness ⅛ in. average)

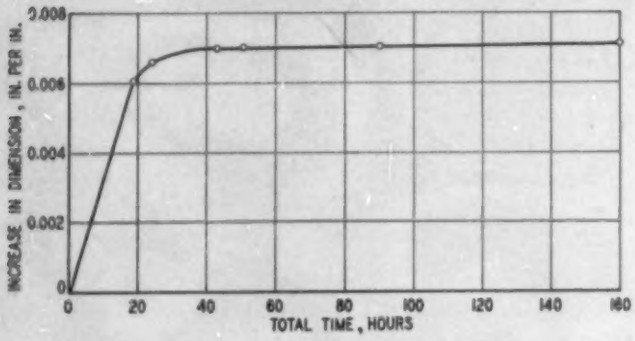

Fig. 22—Dimensional stability at high humidity for molded cellulose acetate

(At 85 percent relative humidity; 85 deg. F. temperature; wall thickness 0.05 in.)

with other materials shown in Fig. 19, an injection-molded cellulose-acetate article showed a shrinkage of 0.013 in. per in. in 24 hrs., though it does not change much after this. It is noted further that the actual shrinkage was dependent upon which portion of the article measurements were taken, with respect to the injection gate.

Cast products of polystyrene and methyl methacrylate are susceptible to further contraction during aging, due in part to further polymerization. In casting these materials from their monomeric form, there is a 15 to 20 percent reduction in volume. Tests upon articles cast of methyl methacrylate revealed that as much as 0.020 in. per in. shrinkage took place over a 24-hr. period at 200 deg. F.

Retention of physical properties after high-temperature exposure

What of the physical properties of the plastics after they have returned to room temperature after being exposed to high temperatures for long periods of time? If thermoplastic in nature and they have suffered a loss of volatile materials which contributed to their impact strength, we may of course expect a diminution of the physical properties. For thermosetting materials, much depends upon the temperature in which the material was operating and the time at that temperature. For temperatures up to 275 deg. F., an improvement in physical properties has even been noted for some of the laminated phenolics. In Fig. 20 some interesting data are given to show the effects of high-temperature exposure upon the physical properties of laminated phenolics. Most of the results are for grade-XX paper-base laminated phenolic plastics, though for comparison, the decrease in impact strength of an asbestos-base material at 300 deg. F. is included. Considerations, such as those which reveal a marked loss in impact strength after being placed in service for a certain length of time, necessitate the provision of ample factors of safety. The significance of the previous history of the material has been emphasized by more than one investigator.[34]

Effect of moisture on permanency

A few remarks on the effects of moisture on the physical properties will serve to emphasize this important influence on the permanency of the characteristics. Much study has been given to the changes in physical dimensions of various organic plastics upon exposure to moisture.[35,36] This consideration of permanency is of particular import when the molded articles are to operate in high humidity or in water. For example, laminated phenolic bearings operating in water must be designed with adequate shaft clearance to prevent seizure when the materials swell slightly in the course of time. The author has conducted several tests in a highly humid atmosphere to illustrate the effects of high humidity upon dimensional stability of typical molded articles, Figs. 21 and 22. These data are given primarily for illustrative purposes, as no attempt was made to investigate thoroughly the question of moisture absorption. The designer is cautioned to make adequate allowance for swelling when the plastic parts are operated in water or high humidity. Particularly noteworthy is the more rapid permeation of moisture in the cellulose structure than with the molded phenolics. Under the same conditions of test, polyvinyl chloride acetate and methyl methacrylate showed no measurable change in 48 hours.

In conclusion it must be emphasized once again that there are many factors affecting the permanency of the physical properties of plastics. This paper has attempted to deal with the fundamental aspects of one of the most significant factors, plastic deformation under stress. Further, the reader's attention was called to other significant phenomena such as shrinkage at high temperatures, and swelling in moisture for various molded articles, though the analysis of these conditions was not pursued as actively as for the creep and cold-flow phenomena.

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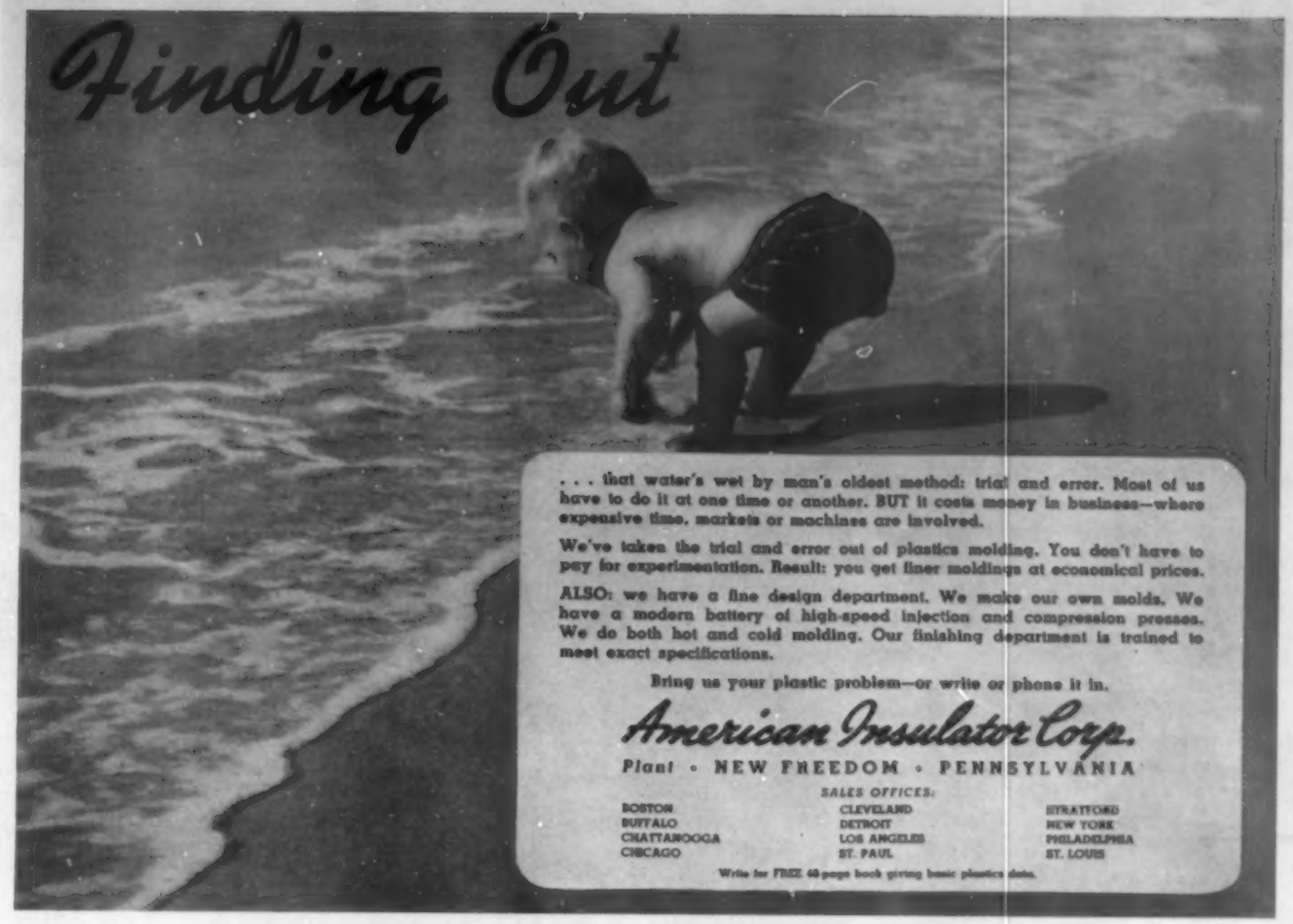
34. Strength of Organic Glasses, by E. Rexer, Zeitschrift für technische Physik, 20, no. 4, 1939, pp. 97–102.

35. Electronic Structure and Behavior of Cellulose Compounds, by G. Kline, Conference on Resinous Polymers, Maryland, Amer. Soc. for Adv. of Science, July 10, 1939.

36. Ethyl Cellulose Films and Plastics, by S. L. Bass and W. C. Goggin, Trans. Electro Chemical Society, 74, pp. 47–65.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Aniline-bagasse plastics

(*Continued from page 61*) This temperature was maintained for 7 minutes, following which the mold was cooled, under pressure, to 200 deg. F., and the piece ejected. Molding pressure was 3500 lb. per sq. in. Complete molding cycle was about 35 minutes.

Moisture-resistance test pieces were made in a 3-in. diameter disk mold, following the same procedure as with the flexural and impact test pieces. This molding cycle was 22 minutes.

The ash trays used for the drop test and as a criterion for molding quality were molded in a single-cavity, positive hand mold. This mold was preheated to 320 deg. F., loaded with molding powder, and pressed at 3500 lb. per sq. in. for 4 minutes. The mold was cooled to 200 deg. F. before opening. Flow was judged as unsatisfactory (incomplete), fair (just complete), and good (complete with considerable flash).

Testing: Test specimens were conditioned for 48 hours at 50 deg. C.[1] Flexural tests were made with a universal testing machine calibrated to read to the nearest 5-lb. interval of load.[2a] Impact tests were made with a standard, 50-in.-lb., Izod impact tester. Both notched and unnotched Izod tests were made, as recommended by Burns and Werring.[3] Because of the large number of powders made for this study, only four specimens were made for each type of test. In cases where individual tests varied greatly from their mean, two additional samples were molded and tested. Scleroscope hardness tests were run on about one-half of the broken flexural test bars, which were selected at random. Bulk factors were calculated from the specific gravity of the molded pieces and the volume occupied by 100 grams of loose powder. The drop test was purely empirical and consisted of dropping molded ash trays successively from heights of 6 ft., 6 ft., and 12 ft., to a concrete floor, repeating the 12-ft. drop until breakage occurred. The figures recorded in Table I show the accumulative height of drop, i.e., the number 36 indicates that the ash tray had been dropped twice from a 6-ft. height and twice from a 12-ft. height before breaking.

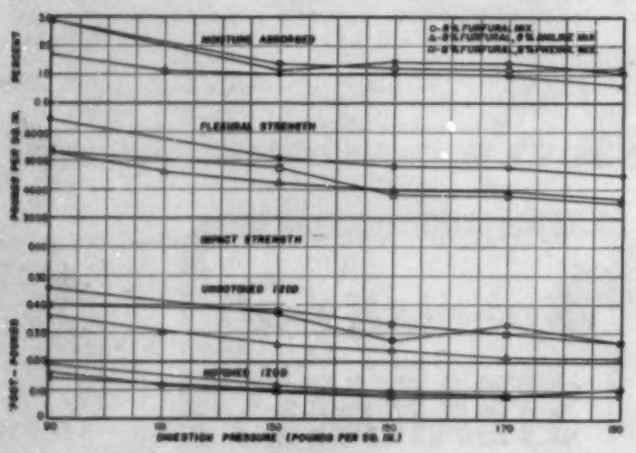


Fig. 1—Effect of digestion pressure on strength and water resistance of aniline-bagasse plastics

Discussion

The preparation data for all powders and results of tests of the powders are shown in Table I. The effect of digestion pressure is shown in runs 1 to 6A, inclusive, and is illustrated graphically in Fig. 1. Generally, water resistance and flow increase with increases in digestion pressure, while all strength properties decrease, as the digestion pressure increases.

Runs 6 to 10, inclusive, shown graphically in Fig. 2, show the effect of digestion time. For any digestion period up to about 2 hours, water resistance increases and strength somewhat decreases with increase in digestion time. Beyond 2 hours, under the other particular conditions chosen for this series of cooks, increases in digestion time do not materially affect the properties of these powders. However, cooks shorter

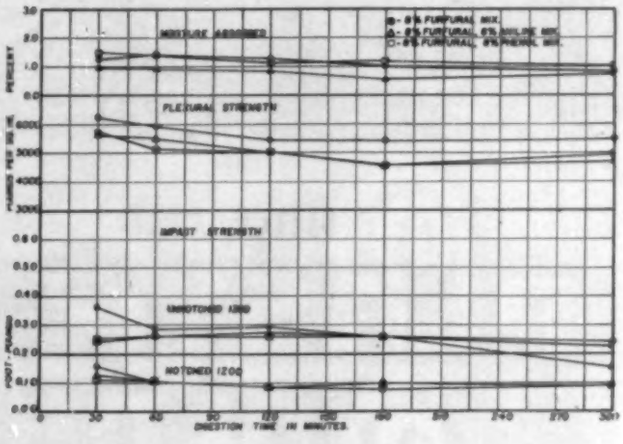
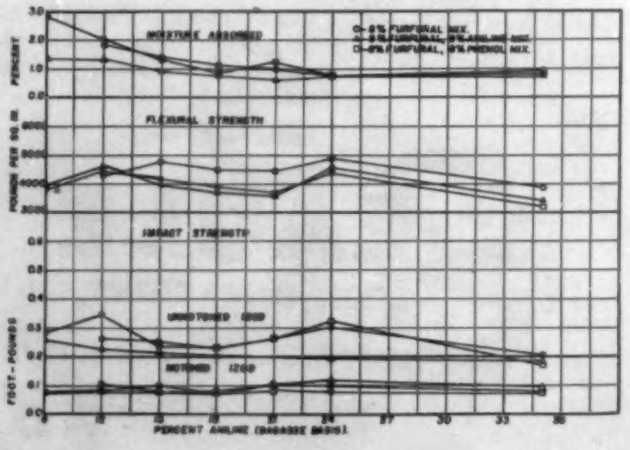


Fig. 2 (above)—Effect of digestion time on strength and water resistance of aniline-bagasse plastics. Fig. 3 (below)—Effect of aniline concentrations in digestion on the same characteristics of the material



[2a] The notched impact strengths of some of these powders were so high with such comparatively low flexural strengths, that it is suspected that the flexural tests reported are low. It is doubtful if the testing machine used, a combination 20,000-2000-lb. machine, is sufficiently accurate for use in this work. Results of a single digestion by this method, reported in a previous paper,[4] were much higher.

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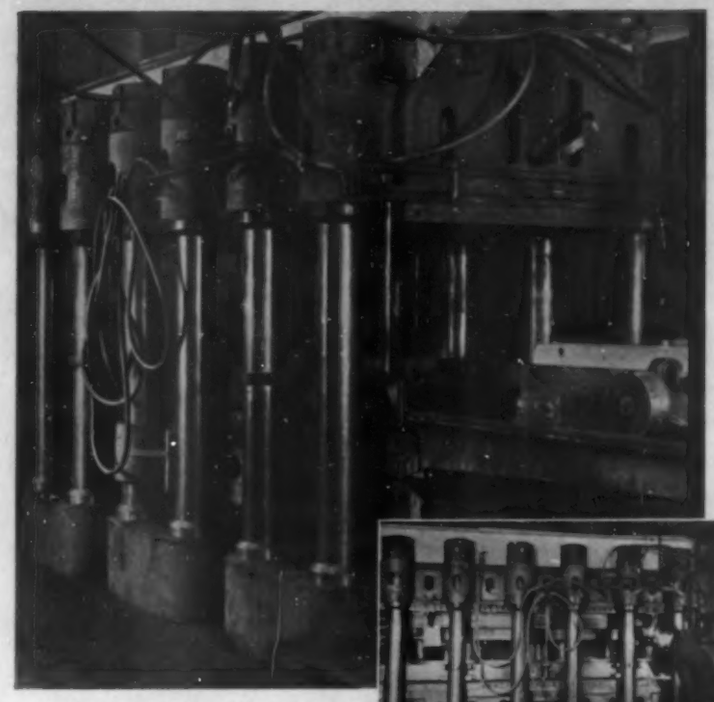

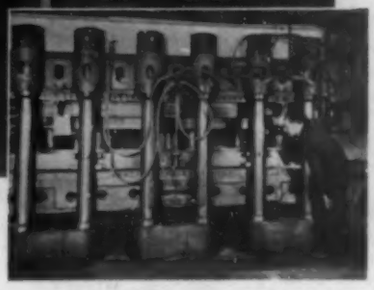

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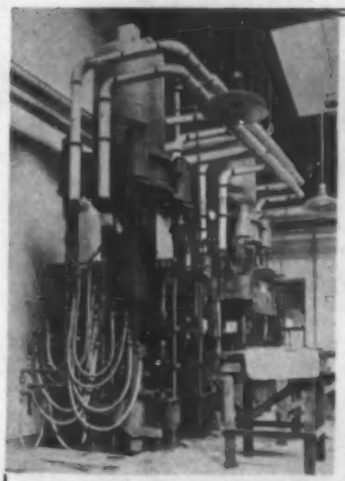

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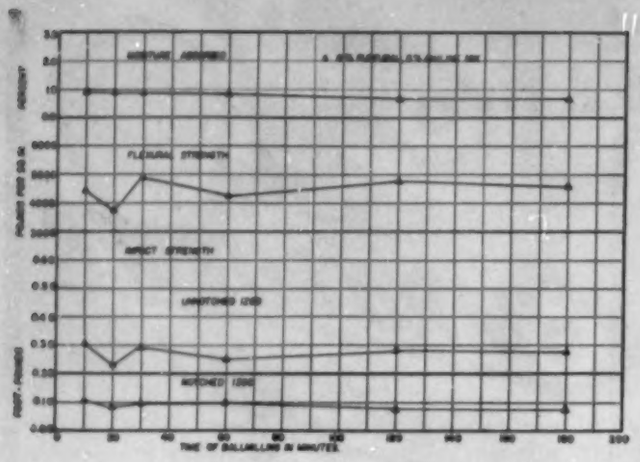

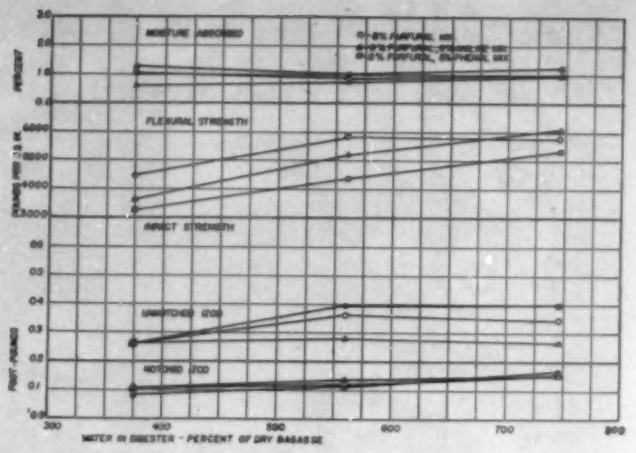

Fig. 4 (left)—Effect of ballmilling time on strength and water resistance of aniline-bagasse plastics. Fig. 5 (right)—Effect of water-bagasse ratio on the same characteristics of the material

than 3 hours gave powders which caused some trouble by sticking in the mold, possibly due to incomplete hydrolysis of plant constituents which are subsequently hydrolyzed during molding.

Runs 6, 6A, and 12 to 19, inclusive, shown in Fig. 3, show the effect of varying the aniline-to-bagasse ratio in digestion. Water absorption decreases to a minimum at a concentration of 24 percent aniline. Strength tests show no very definite trend, although most of the tests seem to reach a maximum at 24 percent. This series shows greater variation between the different plasticizer mixes than do the two preceding series.

Run 11, shown in Fig. 4, was a single test of the effect of ballmilling time. Moisture absorption seems to decrease with increases of milling time, but the strength tests show no very definite trend. However, the unnotched Izod impact strength apparently slightly increases and notched impact strength slightly decreases with increase of ballmilling time. It should be noted that the 20-min. mix in run 11 duplicates the 8 percent furfural mix in run 4 and that the strength and moisture absorption tests for both powders check very closely. From these results, it may be inferred that a powder can be closely duplicated and, also, that the arbitrarily selected ballmilling time, used in preparing most of these powders, was, unfortunately, the one giving the weakest products, as shown in Fig. 4. While the authors hesitate to offer an explanation for this effect, it is possible that this time of ballmilling, under the conditions of pregrinding, was sufficient to grind the aniline-digested fibers to a very fine state, but was not long enough to permit thorough incorporation of the plasticizing chemicals. The proper degree of incorporation was reached in 30 minutes, and any additional milling only decreased the length of fibers remaining without securing any better reaction in the material. This explanation is offered only as a conjecture and it would require further work to support this hypothesis.

Runs 6- 6A, 23, and 24, which are illustrated graphically in Fig. 5, show how increasing the water-to-bagasse ratio affects the strength and water resistance of these plastics. Moisture absorption is apparently not much affected, although it seems to be at a minimum in powders prepared at the water-to-bagasse ratio of 5.6 : 1. Flexural strength, with the exception of that of the 8 percent furfural mix, and notched impact strength increased with increase in the water-to-bagasse ratio, while notched impact strength appeared to reach its maximum at the 5.6 : 1 ratio.

Runs 21 and 22, which should be compared with runs 6- 6A, and 3, respectively, were made to show the effect of mixing with plasticizers without pregrinding. These runs indicated that powders which are plasticized before grinding are much stronger than those which are ground before plasticizing. The unnotched impact tests gave varying results and do not support or disprove the conclusion. In the case of the digestions made at 190 lb. pressure (6, 6A, and 21), the difference in strength is very great and is noticeable in the resistance of the molded pieces to breakage by dropping.

The material designated at the bottom of Table I as run 18 : 6A was prepared in order to determine the feasibility of adding fillers to these powders to increase the strength. Powder from run 18 (8–8 phenol-furfural mix), which could not be molded, was mixed with varying percentages of powder from run 6A (8–8 phenol-furfural mix), which molded well but was low in strength. The powders thus prepared molded fairly well and had strength tests much higher than those of 6A and much higher than would be expected from the results of runs 16 and 17, which had indicated low strength for powder from run 18. The moisture absorption was quite high.

Runs 2, 5, and 6 were made to determine the effect of the fineness of the powder before plasticizing upon the strength of molded articles. The results of strength tests indicated that the finer grinding is probably to be preferred if it is to be done at all at this stage in the preparation. However, it should not be forgotten that the time of ballmilling selected for this work was not the optimum and that 10 minutes' additional milling might have given different results. (*Please turn to next page*)

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As a further check on the effect of fineness, another digestion (run 20) was made and the resulting digested material divided into three parts. One portion (A) was ground to pass a 6.35-mm. screen and then plasticized. Another portion (B) was screened and divided into parts (B_1) retained on, and (B_2) passing, a 16-mesh window screen. These portions were separately ground to pass a 1-mm. screen and then plasticized. The third portion (C) from the digestion was plasticized while in the unground condition and subsequently screened on a 1-mm. screen (less than 10 percent of this material was retained on the 16-mesh window screen, which was not enough for molding test pieces). The part (C_1) retained the screen was then ground to pass a 1-mm. screen. Powders B_1 and B_2, and C_1 and C_2 (which passed the 1 mm. screen) represent 36.7 and 63.3, and 26 and 74 percent of the original weights of B and C, respectively. Results of tests on these powders, as well as those of runs 2, 5, and 6, indicate that, within limits, the fineness of the finished molding powder does not materially influence the strength of articles molded from it. They also indicate that somewhat better flow, water resistance, and impact strength will be secured from the finest powders providing that the fineness is not obtained through destruction of the original fiber length. That destruction of fiber does take place in the pebble mill is indicated by the fact that the coarse material (B_1, run 20), *which was plasticized after screening*, is only 26 percent stronger flexurally and 55 percent stronger in notched impact than its corresponding finer counterpart (B_2), while the coarse material (C_1), *which was screened after plasticizing*, is 39 percent stronger flexurally and 100 percent stronger in notched impact than its finer counterpart (C_2). These differences are further emphasized when it is recalled that the powder C_1 was screened out on a 1-mm. screen and therefore contained a much higher percentage of fines than B_1 which was screened out on a 16-mesh window screen. The difference in size of screens probably accounts for the fact that B_2 gave somewhat higher strength values than C_2, since the former would contain a higher proportion of coarse material than the latter.

These results indicate the need for some less fiber-destructive method of plasticizing, such as the use of volatile solvents for impregnation, a different type of mixing equipment, or possibly only a modification of the pebble mill so that it will have a less drastic action. For instance, it is thought that the speed of rotation of the machine used in this work might be reduced to the point where only a rolling action of the pebbles would be obtained, rather than the present action of lift and drop, which causes crushing. It is possible that the rolling action would still produce good mixing without excessive grinding.

Results of the preceding runs indicated that to obtain a strong molding powder with a reasonable degree of flow it would be necessary to digest bagasse with a high water-to-bagasse ratio, using about 21 percent by weight of aniline and digesting for approximately 3 hours at moderate pressures, and that the resulting digested material should be plasticized before grinding and should be mixed in a pebble mill for 30 minutes. It was also indicated that 8 percent each of phenol and furfural would be most satisfactory for plasticizing from the standpoints of both flow and strength.

In accordance with the above findings, an additional digestion (run 25) was made with the object of obtaining high strength. The resulting powder was tested, with results as shown in Table I. As was expected, this powder gave stronger articles than any previously made but was somewhat deficient in flow and water resistance. This material seems to have good enough flow properties and sufficient strength for use in the production of such articles as paneling, table tops, tile, etc.

Summary

A series of 24 digestions of bagasse with aniline was made in which each of the factors of digestion (pressure, water-to-bagasse ratio, aniline-to-bagasse ratio, and time) were varied independently while holding the other factors at arbitrarily chosen constant values. The digested products were divided into three or more portions which were used to determine the effects of other factors such as degree of fineness of grinding, different combinations of plasticizers, grinding before or after plasticizing, and time of ballmilling (for plasticizing). Flexural strength, notched and unnotched impact strengths, hardness, water resistance, specific gravity, bulk factor, and molding quality were determined on each molding powder prepared. Comparative drop tests of molded samples were also made.

On the basis of the results of these digestions and tests, conditions were chosen which would be expected to produce a molding compound superior in strength to those in the series of experimental digestions and which would have a reasonable degree of flow. Bagasse was digested under the selected conditions and a molding compound prepared. Test specimens molded from this material gave results in line with expectations.

Conclusions

1. Properties of molding compounds prepared from bagasse by the aniline-digestion method can be varied through a wide range.

2. The water-to-bagasse ratio in digestions should be high for maximum strength and low for maximum flow and water resistance.

3. The aniline used should be from 20 to 25 percent of the weight of original dry bagasse.

4. Digestion pressures should be low for maximum strength and should be high for maximum flow and water resistance.

5. Digestion time should be approximately 3 hours in order to completely hydrolyze the plant constituents which cause sticking in the mold. Shorter times of digestion will increase strength but it is preferable to digest for longer periods at lower pressures.

6. Ballmilling, in the manner used, is not the best method of mixing with plasticizers and seems to destroy fiber strength by grinding. Mixing time is relatively

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unimportant, but should be long enough for thorough reaction and incorporating plasticizing chemicals.

7. Plastic molding compounds can be prepared by the aniline-digestion method with sufficient strength and flow to be used for many articles where low cost of molding powder is of prime importance.[4] The relatively long molding cycle (22 to 35 min.) used in this experimental work could be cut down to a very considerable extent in large-scale commercial practice, using cored multiple molds.

American industrial art

(*Continued from page 48*) fluorescent lighting, are used as murals. William Lescaze also has used wear-resistant, washable laminated plastics for shelves and table tops in his four-year-old's room.

A new type of louvered plastic sheet creates unusual effects in lighting the floral landscapes and other exhibits. Plastics appear throughout the exhibition in decorative accessories, as door handles, drawer pulls, for walls and furniture.

Other new products developed by industry are applied for both functional and ornamental purposes. There are new materials for insulation, sound-proofing, weather-resistance, lighting, and even a new type of nursery drawing board—a white synthetically surfaced glass that replaces the old-time black board. Laboratory-born fabrics appear on every side and in fact, the fire-proof ceiling of the entire gallery is of fabric woven from pure glass. Domenico Mortellito has carved and painted "battleship" linoleum with a synthetic composition that permits startling color effects.

Old and new are combined with pleasing congruity—plastics side by side with mosaics; synthetic textiles with hand-loomed fabrics; a wall of plaster adjoining a wall of woven laminate; hickory chairs on the one hand, aluminum, glass and plastic furniture on the other. Familar standard construction materials are interpreted with zestful abandon. Fabrics, rubber floor tiles, cork and glass climb up walls. Steel, copper and other metals are bent and twisted into artistic shapes. Shaggy carpet hangs from a soffit overhead. Stainless steel, wood and stoneware sit on a dainty dining table.

Modern craftsmanship combines man-made materials and old-stand-bys with an intimacy and originality that charts the route of industrial design for today and foreshadows the traditions of tomorrow.

Spraying metal molds

(*Continued from page 87*) short when compared with machining operations unless the mold is very simple in form. For example, referring again to Fig. 3, which illustrates the button embossing die, we learn that the spraying time for making the small negative of the die in bronze was four minutes. It required approximately five minutes of spraying time to make the duplicate die from the negative. The duplicate die was made of hard steel and later mounted in the metal chase as you see it at the right of the photograph.

Another die, which we were told by the molder couldn't have been made economically by any other method,[1] required about 120 hours to produce. Only 14 hours of this time, however, was needed for the actual spraying, the balance being used in getting the part lined up true, getting a satisfactory model, etc. Even this didn't mean much when the completed mold made it possible to turn out a difficult job in plastics that otherwise might have been impractical to produce.

Limitations and advantages

No one, least of all the inventors and developers of the process, believes that sprayed molds will take care of all the loose ends and time-honored problems of the plastics industry. However, there is a good chance that for certain applications the process will be welcomed and found practical in conventional use, especially for injection molding—and for compression molding, too, where multiple cavities with decorative surfaces are desired. This appears to be particularly true where mold costs and limited time are important factors in meeting production schedules.

[1] We shall present a complete story on this molding job a little later on.

Just relax!

(*Continued from page 35*) operator flips the joint on the lens arm and lets the customer see for himself. This chromium arm supporting the mirror permits it to be moved in a complete circle; in other words, it can be moved in a 360 deg. angle in two meridians.

A covered metal bracket for the lamp was suggested by the molder. The parabolic shade itself is metal, chromium finished, and is designed to focus the light directly on the hand. It is estimated that a 25-watt bulb will give sufficient light for the operations.

The Pro-Care unit is said to be patented and twenty claims are reported to have been granted on the patent. Although the product has just been put on the market, the manufacturer claims that excellent reaction has been accorded the unit at all beauty equipment shows at which it has been exhibited. Its compactness and the beauty of the plastic from which it is molded are among its best selling points. The fact that the unit is not stained by polish, remover, creams, lotions and acids, and that it can be easily and quickly cleaned by applying a damp cloth are points of paramount importance to the 70,000 beauticians who may be using these units in their shops in the very near future. Despite all of its parts, the unit is light in weight.

At the present time the complete unit is being made in ivory urea, but it is planned to mold the circular drawer and cotton picker cover in black for contrast.

The reported fact that this new unit will make better manicures possible in about one-third the time required by previous methods is something to be reckoned with, especially when comfort, efficiency and good design are intelligently combined with low production cost.

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(*Continued from page 38*) manence that defies time and abuse. Then, there is no more danger of rust and corrosion. Easily washed, it remains clean and new-looking in service indefinitely.

Light weight—30 percent lighter than metal—proved another important advantage, as well as a decided economy in shipping. And the outstanding beauty of modern, smooth-flowing design and rich contrasting colors adds to the sales appeal of the product. Cost was another important factor in favor of thermoplastic molding. Although fine, costly plastic materials are used, production speed and efficiency made possible by skilled precision craftsmanship and the injection molding process have, in this case, produced approximately a 10 percent lower cost than that of a metal shell.

Eclipse to order

(*Continued from page 45*) tionary control over brightness, the new Variable Day Glasses have the optical feature of louvered side shields. The louvers, like Venetian blinds in the plastic side shields, effectively block out light that causes back reflections, and transmits light that makes clean side vision possible. This is clearly pictured in Fig. 5.

5

Louvered plastic sides admit light without back reflections

Side shields on eye glasses are not new but these louvered shields are said to be the first ever devised that both block back reflections and permit the clear vision so important for automobile driving, boat racing, and other outdoor pursuits.

Extremely compact and sturdy, these new glasses appear to provide the modern answer to the need for better eye-protection against glare and excessive brightness. In effect, they are equivalent to a whole series of tinted glasses, carefully graduated to pass different amounts of light, combining flexibility with the familiar principles of Poloroid glare control. With their double laminated, ultraviolet absorbing lenses as extra protection against shattering, they are claimed to be the safest outdoor glass that can be bought.

Synthetic resins for corrosion-resistant paints

(*Continued from page 64*) purchaser of these products to specify rigidly the grade and quality of the phenolic resin used, witness the following specifications:[4]

U. S. Navy 52R10.
Bureau of Aeronautics RM 32-1a.
U. S. Engineers, Phenolic Resin Specifications.
Tennessee Valley Authority, Phenolic Resin Specification.
City of New York, Phenolic Resin Specification.

Uses of modern protective coatings

Many of the large consumers of paints have during the past 5 or 6 years set up paint and varnish research and testing laboratories to determine the qualities required and to control and test the products submitted. Examples of some of the fields covered by these new anti-corrosive paints follow.

Protection of steel in river and harbor waters: One of the engineer's greatest corrosion problems has been the protection of steel locks, dams, ships, and other construction in river waters. This has been aggravated by acidity and dissolved salts in the water and by the erosion of flowing silt and casual foreign objects. After years of testing, the U. S. Army Engineers in charge of the twenty-six locks and dams in the Mississippi River have written specifications calling for 100 percent phenol-formaldehyde resins, and for the past two years have used primers and aluminum finishing paints based on these specifications. There are 26 of these dams running from St. Paul to St. Louis, consisting of tainter and roller gates, each 30 feet or so long, and running 15 to 20 in a row. The finish must stand not only occasional, but also long period immersion in the river water in addition to the blazing sun of summer and the ice and frost of winter on the exposed areas.

Similar specifications are in use by the lock and dam engineers in charge of the Tennessee Valley Authority, and Chicago engineering area. The engineers of the U. S. Army, Pittsburgh district, recently issued a report[5] in which they describe the various types of rusting and erosion problems which they face and the successful results of the efforts to combat them. They state that "after considerable experimentation and research over a period of several years, the Pittsburgh Engineer District has found that paint made in accordance with the following specification is far superior to any other for the prevention of corrosion and erosion of ordinary iron and steel structures in the Monongа-

[4] A review of Federal, State, and Municipal Specifications based on these resins is called Technical Bulletin No. 17, issued by the Bakelite Corp. To those interested it is available on request.

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hela River." Then follow the U. S. Engineer's specifications and formulations for anti-corrosive primers and gloss finishing paints, all based on the use of a 100 percent phenol-formaldehyde resin which is itself rigidly specified in order to insure procurement of the highest quality. For example, the resin to be used in the vehicles for both primer and finishing coats shall be rosin-free, shall stand immersion in water, gasoline, and concentrated sulfuric acid, respectively, for 72 hours, and shall show less than 6 percent volatile when heated at 560 deg. F. for 15 minutes.

Similar protective paint systems are now specified for many state, county, and municipal bridges among which may be mentioned the following:

Port of New York Authority: (George Washington Bridge and all other bridges connecting New York and New Jersey).

Triborough Authority: (New York City's Triborough Bridge).

City of Pittsburgh: (Smithfield St. Bridge).

City of Milwaukee: (Example: 35th Street Viaduct).

City of New York: Spar varnish and vehicle for primers and aluminum paints.

Tennessee Valley Authority: Protective primers, paints, and sealers for steel, above and below water, and for concrete.

Protection of the interior of steel water tanks: Another vexing problem of the paint industry and the engineer in the past has been the interior of steel water tanks. Dr. H. A. Gardner, Director of the Scientific Section of the Paint and Varnish Manufacturers Association, stated some eight years ago that if a successful coating for such tanks were developed, it would open up an annual market of over a million gallons. This problem has largely been solved through the use of the water-resistant finishing system somewhat similar to those just described. In 1934 the Pittsburgh-Des Moines Steel Company conducted a test of 196 different paints on the inside of a million gallon steel water tank. Each month the tank was emptied and two inspectors made independent reports. At the end of 18 months the test was discontinued and their Technical Report No. 3301 issued. This report stated that the only finish rating 100 percent in this test was based on a phenol-formaldehyde resin.

Marine coatings and spar varnishes: One of the first fields taking advantage of the water resistance and durability of phenolic resins was that of marine coatings and general exterior spars. Thus, most of the leading spar varnishes on the market today utilize the phenol-formaldehyde resin. The Chris-Craft motor boats and cruisers have for the past three or four years been protected and beautified with three coats of such a spar varnish. Some of the best known anti-corrosive primers and finishing coats for steel ships are based on these resins. The U. S. Navy highest grade spars and ship paints are based on a 100 percent phenol-formaldehyde specification. The Ford station wagon, outstanding as an example of the beauty and durability of a well-protected wood body, has for years been given three coats of a 100 percent phenol-formaldehyde resin varnish. The specifications of the U. S. Maritime Commission for marine "deep tank coatings" are based on similar primers and finishing paints.

Aircraft coatings: The aircraft industry brings us a combination requiring the maximum of protection that science can furnish over light alloys that are readily attacked by salt, moist air. One of the earliest and most stringent specifications embodying the use of 100 percent phenol-formaldehyde was the V-10 specification of the U. S. Bureau of Aeronautics. This phenolic varnish was required not only for a clear spar and aluminum vehicle, but for the anti-corrosive primer (P-23) and the deck and pontoon enamels (M-67) as well. A viscous varnish of the same type is also specified as the seam compound required in rendering all gaskets and seams impervious to salt water and gasoline. The modern zinc yellow quick-drying primer (Specification P-27) for aircraft protection of both aluminum and magnesium alloys is based on highly dispersed phenolic resins. Likewise phenolic resins furnished the base for the protection of light alloys on the huge dirigibles. These included vehicles for the aluminum protective paint and phenolic baking coatings on the inside of aluminum condenser tubes.

Railways, street cars, and buses: A wide variety of protective paints for railways, cars, and buses, based on phenol-formaldehyde resins, is furnished by the paint industry. Freight car paints require this tough type of protection. This is especially so in regard to refrigerator cars in which moisture condensation, and, occasionally, salt solution and fruit acids induce early corrosion. High-speed passenger and freight trains are subject to all kinds of weather and to the erosive action of cinders, smoke, and gases. The Chicago and Northwestern Railway Co. reports that because it stood up under laboratory tests, a phenolic resin finish is used on their famous "400" passenger train.

Other examples of modern paint protection: Many other types of uses where these modern synthetic resin coatings are giving exceptional performance could be cited. A passing montage would include the floors of roller skating rinks, school rooms and gymnasiums, and Hollywood dance sets, the aluminum and black guard rails lining the highways of Minnesota and the inside painting of fish hatcheries in Michigan. (Brook trout are reported to grow faster in tanks painted white with phenolic resin vehicles.) The bronze stair rails and doors of the white marble and bronze U. S. Supreme Court building are guarded against the corrosive acids in the perspiration of hands of visitors by a phenolic resin lacquer. So are the guard rails and interior stanchions of the Wayne passenger buses. Phenolic coatings protect Antioch College fume ducts and many laboratory hoods and tables; they are specified by the State of Vermont to protect maple syrup and sugar from contamination; they coat oil and gas tanks throughout the country and protect millions of

[1] Diffenbach, Corrosion and Erosion in River and Harbor Structures, Industrial & Engineering Chemistry, 30, 1014 (1938).

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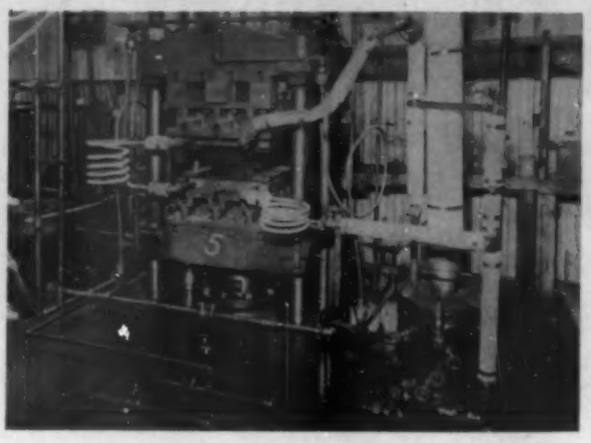

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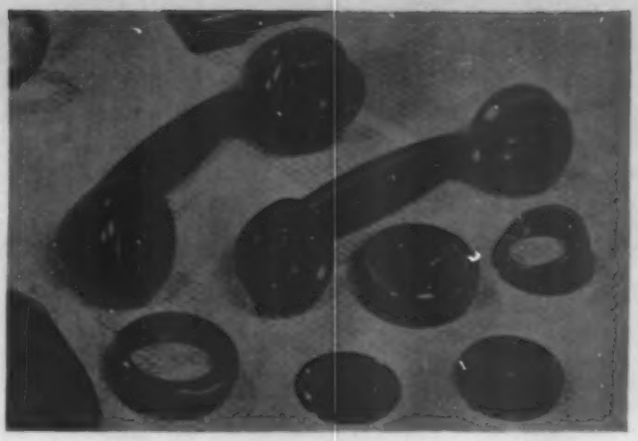

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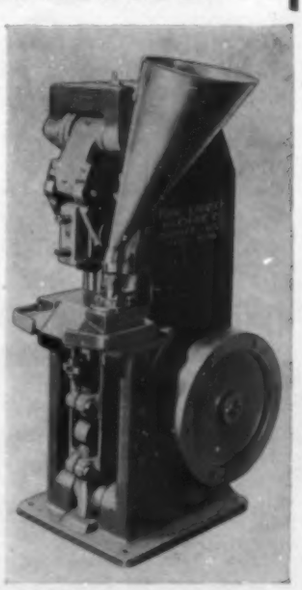

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Conclusion

Through the use of synthetic resins and the study of corrosion the paint and varnish chemist has made available new values in protective coatings. The maintenance engineer is rapidly adopting these through rigid specifications. However, as Dr. F. N. Speller of the National Tube Co., one of our country's authorities on corrosion, points out, "Too often the architect and the engineer are content to follow traditions in specifying material and have been more or less indifferent toward the serviceable life rendered by the structures they design." It is believed that the new cooperation between the producers of paint, the basic raw material manufacturers, and the consumers will result in a unified defense in the war against corrosion, and that the new products will add substantial emphasis to the slogan, "Save the surface and you save all."

5000 dozens sold in 8 weeks

(*Continued from page 49*) that the plastic parts for four brooms come from the press every 55 seconds, or that only about 3 minutes of molding time is required for each dozen brooms.

The cellulose acetate plastic parts require no finishing. They are broken from the main sprue and gates, then assembled in by conventional methods operative in the broom industry. The corn is dyed in colors to harmonize with the red, green, or blue variegated plastic shoulder and hanger and the handle is enameled white.

Although the plastic shoulder is intended primarily to lend color and decorative value to the broom, it also provides protection for the broom corn preventing it from breaking at the top when bumped against furniture in use. The plastic, being smooth and resilient, protects furniture from being scratched by such bumps as well. The plastic hanger provides a spot of color and at the same time is useful for storing the broom.

Manufacturing practice is simplified to such an extent that the broom sells for less than one dollar retail—usually at 89 or 98 cents depending upon conditions in the various communities where it is sold.

"The greatest difficulty in the broom business," writes the sales manager of Rich & France, Inc., "is low priced products and the resulting difficult competition. Though we enjoy a national reputation for producing quality merchandise, it has been difficult for us to sell as many distributors as we would like to. With the pastel broom, we have been able to sell jobbers and distributors who have not purchased our regular brooms for many many years. These distributors report that the demand which they have received for this product has far exceeded anything they have ever anticipated, and their repeat orders are coming in much faster than we can possibly supply them, even though we have practically doubled our production."

Meeting competition by improving merchandise and creating new items of superior design and construction offers a refreshing note in today's market. The use of color in plastics is proving to be the incentive for many new merchandising ventures.

Plastics in Peru

(*Continued from page 56*) 50 tons pressure with electric heating (120 to 220 deg. C). The machine requires 50 seconds at 150 deg. C to make a small saucer. The articles being made by this firm are of the following dimensions:

> Small plates, 6 in. diameter; Large plates, 8 in. diameter; Tea cups, 4 in. diameter, 3 in. deep; Saucers, 4 1/2 in. diameter; Tumblers, 3 in. diameter, 5 in. deep;

It is reported that this manufacturer ordered a German injection molding machine (Ecker-Zigler) but that due to the difficulties in receiving shipments from Germany the machine has not been delivered. It is understood that he is already in touch with several American manufacturers of machinery of this type.

The two small firms manufacturing buttons, buckles, brooches, etc., import plastic materials in sheets, and their machinery consists of small lathes, saws, and polishers.

The electric current characteristics in Lima are 220 volts, 60 cycle, 3 phase, A.C.

Considering the size of the Peruvian market and the limited purchasing power of the masses in general, new and increased applications of plastic materials by local manufacturing of finished articles that would seem feasible are: combs, buttons, door knobs, light fixtures, pens, compacts, jewelry, spectacle frames.

From our mailbox

Editor, Modern Plastics:

That is a very interesting article—"Molding Photographic History"—in your April issue. As Mr. Simmons points out, the use of molded plastics for photographic equipment dates back many years.

A few months ago I had the opportunity of inspecting what is probably the first candid camera molded of Bakelite phenolic material. It is the property of Dr. T. K. Peters, Director of Archives of Oglethorpe University, and was designed and produced by him. The camera is in good condition as the attached photograph will bear out.

As a matter of historical interest to the plastics industry, this is the way Dr. Peters describes this development:

"Just prior to the declaration of war by the United States against Germany and the Central Powers, I was engaged as technical expert at the Fort Lee Studio of the World Film Company. Realizing the necessity for mapping from an airplane in the event of war, which seemed imminent, I began experimental work in connection with an automatic camera, utilizing the motion picture film, with an automatic gear operating from an airfoil which would take pictures from an airplane every ten seconds, more or

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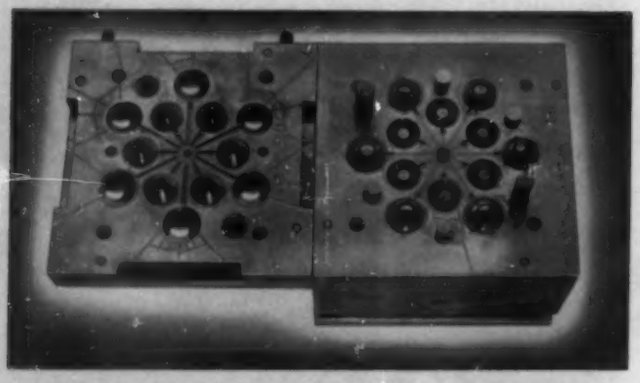

TOOLING IS A JOB FOR EXPERTS

The outstanding success of SINKO injection moldings is due largely to the unusual skill and accuracy of our tooling division. For here, working in close cooperation with our expert plastics molders, are engineers, metal craftsmen and modern tooling equipment, all geared to produce the most intricate or the simplest molds with a degree of exacting precision which we believe is unsurpassed in the history of injection molding. Consult our engineers on your thermoplastic problems. Speedy injection molding, as we produce it, may prove more efficient and economical for you.

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351 NORTH PULASKI ROAD, CHICAGO, ILL.
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Over eighteen years ago, this candid camera with its molded Bakelite case, was designed and produced by Dr. T. K. Peters, now Director of Archives of Ogelthorpe University

less, depending upon the speed of the airplane. The airplane in reconnaissance would produce with this camera a continuous map out over the enemy's lines. Each frame on the film had fine cross hairs on its surface and at the bottom an altimeter reading made through a rotating altimeter dial. The camera held two hundred feet of film.

"When finished, I took this to Washington and submitted it to the photographic section of the Signal Corps. I was advised by Major Brown that there were a number of cameras operating in the same manner and having film of larger dimensions which did not need the extreme magnification necessary with my machine.

"The attention of General Squier was called to the altimeter, however, with the result that I was asked to engage in the manufacture of altimeters which were badly needed, and was given a contract for five thousand altimeters by the government. This effectively killed my idea of manufacturing the camera for war time purposes. However, in 1921, the project was revised to make microfilm images of books which I could carry with me on an expedition to Asia, which at that time was being contemplated. I also thought it had possibilities for use as a small compact camera, which could be carried on my expedition, and, as it would hold the standard motion picture film, and as originally contemplated, take one hundred feet of film or eight hundred exposures, it would prove to be a very handy device. I built several models of wood. In the meantime, having moved to Los Angeles, I decided to go into the manufacture of these cameras and an advertising device used in connection with it on an extensive scale. In 1922, I secured the services of a die maker and molder named Brediger, who had a small experimental molding shop in Los Angeles. He was producing moldings for some automobile concern there. I gave him the drawings for the machine with the result that the camera shown in the picture was produced in Bakelite phenolic material, as well as two magazine boxes which hold fifty feet of motion picture film.

"As it was impossible to secure a basic patent upon the use of this type of camera, it was subsequently copied in modified form by several other concerns, but I believe my camera to be the original camera of the so-called candid type, utilizing 35 mm. film for the double frame of 1 by $1^1/_2$ inches as a picture size. The original molding has not warped or become distorted in its eighteen years of use."

Very truly yours,
BAKELITE CORPORATION
(*Signed*) Don Masson
News Editor

April 18, 1940
247 Park Avenue
New York, N. Y.